DOCUMENT RESUME

ED 161 714 SE 025 177

AUTHOR Hofman, Helenmarie, Ed.
TITLE A Working Conference on Science Education for Handicapped Students: Proceedings (April 3-5, 1978).
INSTITUTION National Science Teachers Association, Washington, D.C.
SPONS AGENCY National Science Foundation, Washington, D.C.
PUB DATE 78
NOTE 392p.; Not available in hard copy due to numerous small and light type throughout entire document

EDRS PRICE MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS Blind Children; *Conference Reports; Crippled Children; Curriculum; Deaf Children; *Elementary Secondary Education; Facilities; *Handicapped; Handicapped Children; *Handicapped Students; Instruction; Instructional Materials; *Physically Handicapped; *Science Education

ABSTRACT

This conference attempted to assess the state of the art and develop recommendations for new directions in science education and careers in science for the handicapped student. Panel discussions were held on such topics as: (1) attitudinal barriers and other obstacles to handicapped students; (2) current practices relating to all physical handicaps; (3) mainstreaming and the law; (4) current practices related to auditorially handicapped students; (5) visually handicapped students; (6) science education, the handicapped, and careers; (7) orthopedically handicapped students; and (8) science careers for handicapped students. Through working sessions the conference participants developed a position statement of science education for the physically handicapped student. Recommendations for action are addressed to various groups. (Author/BB)

NATIONAL SCIENCE TEACHERS ASSOCIATION

A Working Conference on

Science Education for Handicapped Students

PROCEEDINGS

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EDITOR

April 3, 4, 5, 1978
1742 Connecticut Avenue, NW, Washington, DC

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Working Conference on Science Education for Handicapped Students

APPENDICES

INTRODUCTION

The purpose of the National Science Teachers Association Conference on Science Education for Physically Handicapped Students was divided into three goals:

- to provide an assessment of the state of the art;
- to make recommendations to federal, state, and local agencies, institutions and organizations for science education and careers in science and related fields for physically handicapped students;
- to ultimately affect the quality of science education for physically handicapped students.

The NSTA working conference on Science Education for Physically Handicapped Students was held 3, 4, 5 April 1978 at the Sheraton National Hotel in Arlington, Virginia. The conference was supported by a grant from the National Science Foundation. Attending the conference were participants representing scientists, students, educators, administrators, parents and counselors, session leaders, staff and conference committee members. The committee represented the following groups:

American Association for the Advancement of Science
Association for the Education of Teachers in Science
Bureau of Education for the Handicapped
Career Scientists
Closer Look
Council for Elementary Science International
Council for Exceptional Children
National Science Teachers Association
Science for the Handicapped Association

The planning committee announced the conference and a call for papers went out in September 1977.

Ultimately, the incorporation of physically handicapped students into science classes, K-12, should be the result of the NSTA conference. This goal would allow these students to pursue further training and/or careers in science and related fields. The recommendations should be instrumental in motivating the appropriate agencies, institutions and organizations to implement services which will help reach this final goal. There has been support by the majority of the participants on the recommendations.

For the national conference to have been successful, the recommendations must reflect the thoughts and experiences of the handicapped; their parents and teachers; scientists, students, educators, counselors; and the intersections of these various groups. Thirty percent of the participants representing these groups were handicapped people. The 800,000 physically handicapped students in the United States now have the right to the least restrictive, most appropriate education. This education, as authorized by Congress, includes the right to assistance for the pursuit of careers in science. Current practices in providing science education to physically handicapped students were assessed and an appropriate direction for future practices was developed at the conference. The success of the conference will be determined in two ways:

Short term -- through this publication of the conference and the evaluation of the conference (see appendix);

Long range -- through indication of change in the quality of science education for handicapped students and through evidence that these students are entering science and science-related careers.

Helenmarie Hofman

SUMMARY OF CONFERENCE PROCEEDINGS

OPENING REMARKS

The conference was opened by the chairperson, Kenneth Ricker. Dr. Ricker presented the rationale and the anticipated results of the conference. John Akey, President, National Science Teachers Association and Director of the NSTA Handicapped in Science Program, welcomed the conference participants and expanded on the project background. Martha Ross Redden of the American Association for the Advancement of Science discussed some of the AAAS Office of Opportunities' programs for handicapped scientists.

PANEL I: We Are People

Attitudinal barriers and other obstacles to handicapped students were discussed by a parapalegic meteorologist, a blind kindergarten teacher, a deaf physicist, and a science professor who was stricken with polio. The panel members related personal experiences in their educational backgrounds which contributed to their pursuit of careers in science.

PANEL II: Current Practices Relating to All Physical Handicaps

Successful existing programs for physically handicapped children in kindergarten science, marine science, and environmental center, and a science museum were described.

LUNCHEON: Mainstreaming and the Law

Fred Weintraub, Council for Exceptional Children, specifically focused on PL 94-142; the most appropriate, least restrictive environment for handicapped students, and common misconceptions about this law. Patricia Morrissey, Bureau of Education for the Handicapped, addressed Section 504 of the National Rehabilitation Act.

WORKING SESSIONS: (five such session were held)

Conference participants were divided into four working groups with individuals such as educators, counselors, scientists, and parents representing different interests in each group. These groups were charged with defining the state of the art of science education for handicapped students and preparing recommendations for future directions in this area.

PANEL III: Current Practices Related to Auditorially Handicapped Students

Panel members (two of whom were deaf) discussed science education for deal children in the mainstream and in the special classroom. Discussion included a review of pertinent literature.

SPECIAL PANEL: Film and Slides

A film was shown of handicapped children in a mainstream laboratory setting at the Horace Mann School in Washington, D.C. Slides and narration depicted mainstreamed blind students functioning in a biology class.

PANEL IV: Current Practices Relating to Visually Handicapped Students

Programs for partially sighted students at the junior high level, laboratory sciences for blind students, and teaching human reproduction to visually handicapped students were presented. The panel also discussed biology models and activity-based equipment designed for blind students,

LUNCHEON: Science Education, the Handicapped, and Careers

Maynert Kennedy, Biological Sciences Curriculum Study, discussed the BSCS model program for handicapped elementary students. A written letter of support was delivered to the conference from Senator Muriel Humphrey.

PANEL V: Current Practices Relating to Orthopedically Handicapped Students

The parent of a multiply handicapped non-verbal child related the progress of his/her son, Ricky, in a regular classroom. (Ricky, who was present for the entire conference, demonstrated his ability to communicate via a computer.) Program development and support models were discussed as well as computer assisted learning.

PANEL VI: Science Careers and Physically Handicapped Students

A project for a science career information center for physically handicapped individuals and an intervention program for occupational stereotyping of deaf students were described. A geologist cited her personal success in geological studies despite the fact that she uses a wheelchair. A rehabilitation counseling program for attracting disabled high school students into college science careers was also presented. Panelists concurred that every science career is potentially open to the handicapped.

WORKING SESSION REPORTS

Session leaders gave their group reports and recommendations.

SUMMARY CONFERENCE ANALYSIS

Mary Budd Rowe, Professor, Institute for Development of Human Resources, University of Florida, discussed her work with research relating to handicapped children with illustrated the conference objectives. Alan Humphreys, Associate Professor of Science Education, University of Minnesota, synthesized the outcomes of the conference.

WELCOME - Kenneth Ricker and John Akey

Dr. Kenneth Ricker, Conference Chairman, greeted the participants and introduced John Akey, Science for the Handicapped Project Director, and the rest of the Conference Planning Committee members present (Martha Ross Redden, Benjamin Thompson, Patricia Morrissey, John Schaff, Phyllis Stearner and Virginia Stern, as well as National Science Teachers Association Staff members Marily DeWall, Helenmarie Hofman, and Ellie Snyder.

Dr. John Akey also extended welcome to the participants and presented the charge for the working conference. Dr. Akey described his life with his father who has been in a wheelchair for many years yet remains an active individual. Dr. Akey then introduced Dr. Martha Redden, Office of Opportunities, American Association for the Advancement of Science.

WHAT IS THE STATE OF THE ART?

Martha Ross Redden

This occasion is a fulfillment of a dream that was begun months ago. You as well as the different groups of people that you represent have the potential to make an even greater dream come true and that is that all handicapped children across our land will have access to a quality science education. It will allow them to live richer lives and even to choose science as a career. What is the state of our science education for handicapped children in our land today? This is a question that must be answered. When the answer is found, we must use the resources available, attack the problems that remain and work together to bring the changes that will assure that the state of the art in the future is adequate to promise this quality science education that we desire for all children, certainly including handicapped children.

What is the state of the art of science education for handicapped children in our country? This question was first asked of me over three years ago by Dr. Phyllis Stearner, who is here today. Shortly after legislation was approved that assured the rights of handicapped youth to an education, a group of disabled scientists began working with the AAAS to identify the major problems of handicapped people as they relate to science. Dr. Stearner was particularly interested in surveying nationwide the science education opportunities for physically handicapped youth. Following her leadership, the AAAS Project on the Handicapped in Science conducted a nationwide survey in 1975. In each state, the chief state school officer, the state director of special education, and the state supervisor of science education were asked to describe the science education program and curriculum available for the physically handicapped youth in that state. The same question was asked of schools for the deaf and the blind in each state. The response that came from that survey was indeed bleak, for there was not a state in the country that could define for us the science program for the physically handicapped youth. One state replied that there were not enough children with physical handicaps in that state for anyone to have ever developed a science program! We were greatly alarmed at the results of this survey. However, the picture was not entirely gloomy, for many of the people who responded to the survey told us of individual teachers who had done a good job teaching science to handicapped children, either in residential schools, self-contained classes in public schools, or in a mainstream setting. At the completion of the survey, we were determined to find these teachers who had offered quality science education to find out what their methods were and their recommendations for others.

Early in 1976, over 500 science supervisors and school supervisors from across the country were asked to identify teachers that they had known to be effective science teachers to handicapped youth. Over 500 teachers were recommended by the administrators. These teachers were then asked to complete a questionnaire describing the setting of their class, the handicapped children in their classes, materials and curriculum they used, adaptations that they had made in these curricula materials, recommendations for other teachers and persons who had consulted with them in their teaching. Over 250 such teachers responded and stand willing to share their experiences with other teachers. Some of those teachers are here today. When we looked for answers to the state of the art question, we became aware immediately that, in spite of the obvious lack of quality science education across our nation, there were many handicapped scientists who somehow made it through a science education and into careers in science. It immediately became obvious that we should ask these people for their recommendations for improving the state of this art.

Soon after the nationwide survey on science education was begun, AAAS began to invite disabled scient' to identify themselves in order that they could help us to understand the barriers that they had faced in getting their education and jobs in science and that they would further share with us their coping strategies in overcoming these barriers. The wealth of information that has been received from this group of scientists that now numbers over 800 certainly sheds some light on not only the state of the art of science education for handicapped youth, but how this state can be improved. In this room today, there are also several members of this resource group of disabled scientists who have come here prepared and willing to share with this group some of the information that they have so generously shared in the past with AAAS.

So I ask again, "What is the state of the art of science education for handicapped youth?" I have come to know through the past months something about it. Up until this point, it has been discouraging, but as I look out at representatives of that group of faithful teachers, I see people wo have planned and adapted materials and have been determined to offer the very best of science education to the handicapped students who are included in their classes. And as I look at handicapped scientists who have overcome the barriers faced by the lack of quality science education, and who are ready and willing to share with us the strategies they used to cope with these problems, and when I see, even in this group, young people just beginning to receive their science education, I am encouraged to know that a beginning will be made this weekend to change the course of science education for handicapped youth. That change will be brought about by people like you, scattered across this country, who will work together and inspire others to work to assure that every handicapped child, along with every non-handicapped child, will have open to them the options allowed by the provision of a quality science education. If things are going to change for handicapped youth in science, it is going to start with you.

I challenge you today to work hard, share with us, realize that what you have done is remarkable and important, and help us to understand it so that we'll go back home determined to do our task more efficiently. Work hard. Your work will be the beginning of greater things to come.

PANEL I: WE ARE PEOPLE

<u>Participants</u>:

Herbert W. Hoffman	"The Price of Being Born Disabled"
Carmen Loperena & Catherine Twomey Fosnot	"A Visually Handicapped Student Prepares for a Career in the Field of Education"
Robert S. Menchel	"A Lack of Science Education for the Deaf at the Elementary Level"
Gregory Stefanich	"Accepting the Handicapped"

Phyllis Stearner, Chairperson

THE PRICE OF BEING BORN DISABLED

Herbert H. Hoffman

When one is born with a disability severe enough that society shoves him into educational and social programs (which non-handicapped persons develop), one becomes separated from 'normal' persons. Thus, all through his school years he is forced to learn from other disabled students. Teachers that enter into special education programs do not have an opportunity to interact with the physically handicapped until they are hired by a school. Therefore, the lack of understanding of how to make the disabled students perform at the highest level possible allows teachers to design courses to fit the limitations of his physical handicap. This makes the student fall further and further behind his 'normal' peers. Since higher education and employment for the disabled are still hard to obtain, teachers will often let studies decline to a point that they think should be the level at which their physically handicapped students can perform. Parents of the severely disabled generally agree with the teachers for two basic reasons: 1) The lack of confidence that their child may someday be able to find employment and become a useful part of society. 2) The parent feels sorry for the child and does not want to see him study so hard when he could be enjoying the outdoors or doing his physical therapy which would enable him to do more for himself when grown.

Most sociologists agree that children learn mainly from their parents and peers. Most parents of handicapped children do not give their child the encouragement that he needs to overcome his fear of not becoming useful. The teachers and his peers do not offer encouragement because they too are unable to see any successful handicapped people who graduated from their school. Perhaps this is why the handicapped persons who develop drive and won't take 'no' for an answer are the only ones that beat the system and go on to make something out of their lives. However, these persons are often labeled by teachers, parents, and rehabilitation specialists as 'special', thus putting them above the other students. Most of the other students do not feel they will ever be 'special', and, therefore, they are not encouraged by those few 'special' persons.

The teachers who are handicapped themselves make the greatest contribution to disabled students. If they are lucky enough to teach in a school that has both 'normal' and handicapped students, the contribution is even greater. These teachers can teach the handicapped students from their own experiences, and will often make the students work twice as hard as 'normal' teachers do for they know that if a handicapped child is ever going to get ahead in society, he will have to be twice as knowledgeable as a 'normal' child. The handicapped teacher will imprint on the minds of the 'normal' student that the disabled are the same as anyone else except that they are physically limited. When these students grow up and find employment, they will have more understanding toward the physically handicapped and will perhaps try to change the attitudes toward the disabled. In the long run, I feel it will be the attitudes of our society that will have to be changed if the physically handicapped are going to be able to live a life that is 'normal' and fruitful as possible. It should be remembered that the mind is the most important part of the body, and the physical part can be handled by a robot.

It might seem ironic that three teachers who had the most impact upon my career, as well as my life, were all handicapped. The first was an elementary school teacher in an all handicapped school who had the understanding that I could contribute more if I were allowed to type with my foot (which I did at home) in class. The other two handicapped teachers were a high school English and a high school Science teacher. My English teacher got polio rather late in life, and besides being very good (but hard) as a teacher, she taught us that our physical limitations did not mean that we could not be useful instead of sitting at home and vegetating. She taught us how the power of letter writing could be used to obtain what we wanted out of life. Later this became the way I got the Division of Vocational Rehabilitation to finance my college education and it was also how I became employed. When she was asked to retire because her teaching was not what the school wanted, I received my first look at what society could do if they didn't like someone. This could not happen today -- or could it? Since I was always interested in science, I guess I worked rather hard at it and even though I could not use my hands for lab experience, I watched my fellow students. Sometimes I was able to tell them how to conduct an experiment. My Science teacher, who was handicapped himself, understood this concept the best: it is more important for a scientist to know how and why an experiment is done than to physically go through the motions which a robot can do. This teacher also encouraged me to enter science fairs and spent many long hours with me going over the science papers I wrote. I became the first handicapped student to attend a city and state wide Science Fair -- but not with the approval of the school principal. Since my speech defect made it hard for persons to understand me when it became time for me to explain my science project, I found a fellow studnet to talk for me. Many hours were spent training him about my project and what to say.

I feel a new dawn is breaking for the handicapped with the implementation of Section 504 and of Public Law 94-142 regarding teaching of the disabled. The handicapped are no longer required to attend all handicapped schools, but can attend a school in their own district so they will be among 'normal' students from their own neighborhood (which will also improve their social outlets). This should solve some of the isolation problems that many disabled persons (including myself) faced. These is, however, a danger that the schools will not follow the intent of the law. For example, schools could make only a few classes barrier free and hire a few special education teachers who will develop programs especially for the handicapped. These programs will take the disabled out of the classroom, thereby increasing the isolation problem. If science teachers are allowed to substitute non-lab classes (which HEW allows if cause can be shown), lab sciences are likely to be eliminated because modifications will take the longest. Also, some science teachers and department administrators might not like the idea of having the severely handicapped students in their lab classes where physical limitations may prevent them from carrying out some experiments. It is up to the handicapped scientists to encourage teachers and handicapped students and to aid in the development of modified courses so that maximum education is possible. We should give our knowledge freely to those who want it and those that do not want it.

Once we educate the handicapped persons in science, we have to see to it that science will give them employment. We are asking society to pay for the education of the handicapped in science and we have to answer to them if the graduate is unable to find employment. We must be willing to act as role models and research persons keeping in mind that the disabled person might only have one chance at employment, for the disabled can't pump gas or wait on tables while they are waiting for the right job to come along. Because education has allowed them to know what it is like to be as independent as possible, severe depression will overcome the student if he has to return home where he is not useful. Suicide is often thought of, and depending on the individual's drive, can lead to a deadly end. Employment must follow education.

A VISUALLY HANDICAPPED STUDENT PREPARES FOR A CAREER IN THE FIELD OF EDUCATION

Carmen Loperena and Catherine Twomey Fosnot

THE HANDICAPPED STUDENT'S PERSPECTIVE

Carmen Loperena

I am twenty four years old, of Puerto Rican descent, a graduate student in Early Childhood Education, and a part time teacher of a kindergarten class. My vision is 10/200; I am legally blind. I write this paper because I feel it is of importance to all educators, most particularly educators like a special education teacher I had in elementary school. When I graduated from her class she offered me words of advice. She said I would never graduate from high school and should forget about college. I can still distinctly remember banging my head against my desk until it was bruised and I passed out, because I was afraid of her reprimands if my answers were incorrect.

I was born a healthy, but premature baby. I was placed in an incubator at birth and unfortunately was given pure oxygen. This medical procedure probably saved my life. However, the retinas of my eyes were permanently damaged. Neither my family nor the educational system in my community was equipped to meet my needs. My parents, Puerto Ricans in Manhattan, were trying very hard to assimilate into the American society and I only made that process more difficult. When we went shopping I would pick things up in order to see them more closely. People would stare and my parents would yell at me. I was not allowed to bring friends home and almost always played inside.

In school I was in a "mainstreamed" program. I attended the regular public school classes most of the day. For extra reinforcement of skills, I also was in a "sight conservation" class. Most of my teachers, with a few exceptions, were insensitive and uneducated to my needs. The material was presented totally in written form, either in workbooks or on the chalkboard. Because I couldn't see the work, I fell behind. The teachers wouldn't let me move my chair in front of the board because then the others couldn't see. By the time the other children finished copying the boardwork, and I could start, the teacher would be on to something new. Math was particularly difficult because it was taught totally by writing math examples on the board. I could never finish copying my examples or my homework.

In junior high, science became my most difficult subject. Most of the science I encountered was handled by the teacher in front of the room, and I couldn't see. Sometimes a teacher would allow me to sit very close to her when she did the experiment. This only caused further embarrassment, however, because then the other students would frequently make fun of me. I was never allowed to help in cooking activities or pet care because the teacher thought I might cause a fire or endanger the animal. Frequently in biology, we used microscopes and drew diagrams. These kinds of assignments were impossible for me. I spent hours looking for diagrams that were large enough to copy.

Reading, Spelling, and Writing were of course difficult, too. Not only was it hard to discern the printed word, but English was also my second language and I sometimes needed translations. I tended to reverse certain letters in words, although I saw them in their correct places. Also, even when I used the dictionary, my eyes would misinterpret certain letters in the work and I would misspell the word anyway. It was difficult for my teachers to understand that it was not just that I saw less that fully sighted person, but that what I did see was blurry.

After graduating from high school with passable grades, I decided to attempt college. At first I chose science as a major, but it seemed as if science was a visual field. After a semester of chemistry, which I failed, I changed my major to Education. I had worked with children in day care centers and at camp and had always enjoyed such work. I enrolled at SUNY, New Paltz and began work in Elementary Education.

At first I told no one of my handicap. I was resolved that my life at college would be without embarrassments. However, when exam time came, I could not even finish one exam. It became necessary to tell my professors about my handicap. It became necessary for me to accept my handicap if I wanted to succeed in college.

Gradually I became aware of agencies that helped the blind student. Several of these agencies provided material, specially prepared for the blind. I have listed these agencies in an appendix. Perhaps they can be of benefit to others with handicaps like myself or educators working with visually disabled students.

With the acquisistion of a monocular, a seeing eye dog, Maggie, taped books and large print materials, my college courses became a little easier and I really began to enjoy education. Unfortunately, Professional Core loomed ahead. Professional Core is composed of five methods courses and requires participation in a classroom. It is taken the semester before student teaching. Science was one of my methods courses and it again was a major problem. Our first assignment was to bring in an insect that crawled, hopped, or flew. This was difficult since I had never seen an insect clearly. A friend caught one for me and I brought it to class, however, I couldn't see it well enough to identify it. When the instructor discussed millipedes and centipedes, I couldn't tell the difference between the two words, nevermind the two animals. This didn't worry me too much, except that one of these two types of animals was possibly dangerous and I couldn't tell them apart. When the instructor went on to reptiles and amphibians, I thought the class would improve. After all, I did know what a turtle was. Unfortunately, the instructor discussed scales as a criterion and I didn't even know what scales were.

All my science experiences were not frustrating, however. There were moments I tremendously enjoyed, such as when we worked with electricity and later, plants. When I had materials I could touch and work with I was thrilled. Experiments to find "what will happen if...." that I could feel and view closely myself left me exhilarated.

My classroom participation was very rewarding, also. I worked in a first grade classroom. When away from the pressure of books and actively involved with children I was happy. And, I knew I wanted to give children the experiences of learning first hand, by active involvement themselves, that I had never had.

I looked forward to student teaching with mixed emotions. Although I knew I would be actively involved with children and that excited me, I was uneasy and frightened of failure. When I interviewed with my supervising teachers, they immediately made it known to me that if any limitations presented themselves in the classroom they would have to be designated on my certification. We also discussed the expectations that each of us had of student teaching. I learned my assignment would be two kindergartens; I would spend eight weeks in each. When I left the interview I felt a bit better.

The first few weeks of student teaching I observed the master teacher closely. There were times when I didn't understand her actions but I never asked questions, so as to appear intelligent. Later when I began to work with the children many of my questions were answered.

One of my fears had been that I wouldn't be able to see the children clearly enough to diagnose their needs. I soon quickly came to realize, however, that I was gaining a great deal of insight even with handicapped vision. I also felt good about my lesson plans. It was easy for me to motivate the children and get them involved in thinking.

One day a substitute teacher was in for the regular gym teacher. When I took the kindergarten class to gym, the substitute mistook me for the teacher. This incident gave me great hope. I was beginning to feel that I might actually become a teacher. For one of the few times in my life, I was beginning to feel like a success.

THE EDUCATOR'S PERSPECTIVE

Catherine T. Fosnot

When I was first approached by the coordinator of student teaching about having a visually handicapped student teacher in my class, my immediate reaction was no. I had recently had a baby and was trying to cope with family and work responsibilities together. I felt a visually handicapped student would need a great deal of work and time from me that perhaps I could not give. I also wondered, admittedly, how we could fully certify her to work with children. Would she really be able to manage a whole classroom of children alone if she could not see them? I consented to discuss these problems with her.

At our first meeting, I was so struck by her fierce determination and drive that I immediately knew we had to accept this challenge together. Carmen openly faced her weaknesses and limitations.

In her previous education she had been given almost no phonic tools for sounding out words. Because of her visual handicap, she had also had limited experience with the printed word and therefore often mispelled words or reversed letters when trying to write down children's experience stories. Her printing was also difficult to read at times since her letters were not uniform; details were hard for her to discriminate. She could not read stories to the children, nor play a musical instrument. She felt insecure with arts and crafts, cooking, manipulatives, blocks, and environmental activities because she, herself, had had little experience with them. Visual discrimination and visual memory games were difficult. Yet all these activities were a large part of the kindergarten program. Management of the whole classroom and group meeting times were obviously difficult, also. From across the room she could see shapes, but no faces. The playground presented the same problems in an even exaggerated degree. I also worried about the presence of Carmen's seeing-eye dog, Maggie, in the room. Would she knock over children's work, step on materials, or disturb children's play?

In some ways the limitations seemed insurmountable and yet I knew with Carmen's courage and determination, and a little creativity, from both of us, we could discover alternative methods of teaching.

Carmen had strengths and talents, also, which we discussed. For years she had trained her memory to be an aid. She had learned to study by listening to tapes, to assimilate boardwork before it was erased, to remember details she might not see again. She was a very creative individual, also. Since she had been forced to find alternative methods of learning in school, she had developed an ability to solve problems creatively. Thirdly, she had tremendous drive. She was a hard worker and was willing to spend long hours in school, before the children arrived and after the children left. We decided to put her strengths to use.

To achieve successful management of the class, Carmen would arrive at school about an hour before the children and set all the activities up so that when the children began to arrive she could concentrate on what they were wearing, their body build, hair color and length, and the sound of their voices. This aided her in recognizing the children across the room and in the playground. She also kept her monocular close by in case she needed it.

At first, she had difficulty controlling her voice. When she felt she was losing control over the group her voice level rose. This only made the group more excitable. I suggested that she might possibly be trying to compensate for her blindness, assuming the children couldn't see or hear her since she couldn't see them. Once she realized the reasons for her behavior, change occurred. Together with the children she worked out signals to use when the class seemed to be getting too noisy or out of control. She flipped the lights to tell the children to "freeze." She could then focus them back in on constructive activity. I remember one day when the class was particularly "high". She flipped the lights and had all the children lay very still and told them a story about an island with no noise. The children instantly calmed to the sound of her voice.

Sometimes when there were special projects planned, Carmen would utilize a tape recorder. Since she was familiar with the tape recorder as a teacher, she used it as a teacher for the children too. She devised a lesson that was self-directed and self-corrective. That enabled her to move around and work with the other children.

In the beginning of her student teaching experience she worked only with small groups in cooking, blocks, manipulatives such as lincoln logs or tinker toys, and arts and crafts. This gave her a chance not only to get to know the children, but also to have some first hand active learning experiences herself. Soon she began to feel at ease with the materials and really enjoy the process of education for she was experiencing the joy of learning along with the children.

Hard work was the key in developing better printing. Carmen spent long hours practicing printing neatly and uniformly on lined paper. Today I think it would be impossible to discern Carmen's written work from mine.

To develop better phonic skills, Carmen and I sounded out words together. I helped her break the word into syllables and try to spell it instead of spelling it for her. She also used the dictionary frequently. This was a great learning experience for the children, also.

Carmen familiarized herself with Parquetry blocks as a method of teaching visual discrimination skills. By using her sense of feel she could determine if the child had reproduced the pattern correctly. She also prepared extensive games and visual materials to use that were large enough for her to see.

Story time, however, remained an obstacle. Carmen could not read to the children. Finally her creativity blossomed. One day she had the children paint pictures of their favorite animals with flourescent paint. Then she asked them to tell her something about their pictures. She put their responses on tape and bound the pictures into a book. The next day at story time the children listened to their talking book and looked at it under a black light. Since then she has used flannel board stories, records, and even memorized large print books.

Maggie, Carmen's dog, never presented difficulties. The children immediately fell in love with her and she became an integral part of the class.

As the period of student teaching drew to a close, Carmen and I began to discuss her future plans. Although she had made tremendous progress and I felt she could manage a classroom alone, there were areas in which she still felt weak. She decided to continue her education on the graduate level in Early Childhood Education and requested to work part time with me in the classroom. Taking theory courses and being able to implement it in the classroom seemed ideal.

Today as I view Carmen working with the children in the class she seems a teammate rather than a student. Observers walk into my classroom and find it hard to believe she is blind. Frequently she substitutes for me. We know the future will still be rocky; she will have to deal with attitudes of the public and administration. But, with her determination I know she will succeed.

Carmen has gained a lot from our experience together but I feel I have also. She taught me new ways to approach teaching and helped me develop a sensitivity to the handicapped. But, most of all I've gained a close and dear friend.

APPENDIX A

AGENCIES THAT CAN HELP

STATE AGENCIES

1. State Commission of the Visually Handicapped
89-02 Suffern Blvd.
Jamaica, NY 11435

Provides the visually handicapped student with financial aid for education beyond high school.

2. Recordings For the Blind
215 E. 58th St.
New York, NY 10022

Tapes text books and lends the tapes to the visually handicapped.

3. The Light House
111 E. 59th St.
New York, NY 10022

Provides the visually handicapped with the tools or skills needed to cope successfully in a sighted world.

4. Guiding Eyes
Granite Spring Road
Yorktown Heights, NY 10598

Trains guide dogs.

NATIONAL ORGANIZATIONS

1. American Association of Workers for the Blind
1511 K Street, N.W.
Washington, D.C. 20005

An association of professionals, individuals, and agencies interested in the general welfare of blind persons.

2. American Council of the Blind
818 18th Street, N.W.
Suite 700
Washington, D.C. 20006
Principal publication: Braille Forum, bimonthly.

An organization of blind persons with chapters throughout the United States; its purpose is to improve training and employment opportunities for the blind.

3. American Foundation for the Blind
15 West Sixteenth St.
New York, NY 10011
Principal publication: New Outlook for the Blind, monthly.

Serves as a clearinghouse for information about blindness; offers professional consultation to governmental and voluntary agencies for the blind; publishes extensive material on blindness; sells aids and appliances for the blind.

4. American Library Association
Health and Rehabilitative Library Services Division
50 East Huron St.
Chicago, Illinois 60611
Principal publication: Health and Rehabilitative Library Services, quarterly.

A professional organization of librarians concerned with services to persons with visual, physical, health and/or behavioral problems. Promotes the development of standards for materials, services and personnel; encourages cooperation among agencies and organizations in publicizing and implementing library services to the handicapped.

5. Association for Children With Learning Disabilities
5225 Grace Street
Pittsburgh, Pennsylvania 15236
Principal publication: Items of Interest, monthly.

Includes parents of children with learning disabilities and interested professionals; disseminates public information.

6. Association for Education of the Visually Handicapped
1604 Spruce Street
Philadelphia, Pennsylvania 19103
Principal publication: Education of the Visually Handicapped, quarterly.

A professional and parent organization interested in the education and guidance of blind and partially sighted children.

7. Council for Exceptional Children
1920 Association Drive
Reston, Virginia 22091
Principal publication: Exceptional Children, 9/yr.

A professional organization concerned with children who have special educational needs; publishes materials on special education and serves as a clearinghouse on exceptional children in the nationwide Educational Research Information Center network.

8. Goodwill Industries of America
9200 Wisconsin Avenue, N.W.
Washington, D.C. 20014
Principal publication: GIA News, biweekly.
Aim, monthly

Federation of local Goodwill agencies concerned with providing vocational rehabilitation services and employment opportunities for the handicapped.

9. Hadley School for the Blind
700 Elm Street
Winnetka, Illinois 60093

Offers correspondence courses in both braille and recorded forms to blind and deaf/blind students and adults; service is free and world-wide.

10. Handy-Cap Horizons
3250 East Loretta Drive
Indianapolis, Indiana 46227
Principal publication: Handy-Cap Horizons, quarterly.

Organization of handicapped persons interested in world travel; group tours are conducted.

11. Library of Congress
Division for the Blind and Physically Handicapped
1291 Taylor St., N.W.
Washington, D.C. 20542
Principal publications: Talking Book Topics, bimonthly.
Braille Book Review, bimonthly.

Provides a free library service to visually and physically handicapped persons through a network of cooperating regional and subregional libraries across the country.

12. National Society For The Prevention of Blindness
79 Madison Avenue
New York, NY 10016
Principal publication: The Sight-Saving Review, quarterly.

Sponsors programs of public and professional education, research, and community services in the area of sight conservation.

13. Special Education Information Center
Box 1492
Washington, D.C. 20013

Disseminates information on special education facilities and services for handicapped children.

A LACK OF SCIENCE EDUCATION FOR THE DEAF AT THE ELEMENTARY LEVEL

Robert S. Menchel

Serving in the capacity of a role model for the handicapped, the author has been able to observe at first hand the science programs being offered to the deaf in his lecture tour across the nation. Serving in this role model, as well as the fact that the author is deaf himself, has allowed him to speak with the students and the science teachers, unrestricted. Furthermore, the author is a Sr. Physicist with 16 years of work experience and has had over eight years of experience teaching science and math to the deaf at the elementary and college level, so he is quite qualified to evaluate the observed science programs in the schools he has visited. At the time of this writing he has visited 25 schools in ten (10) states.

These observations have shown that at the elementary level and even at the high school level there is a lack of science education in schools for the deaf, both special and public. This lack of the development of a basic science curriculum from kindergarten to the twelfth grade is a national disgrace and one that puts the deaf child at a disadvantage in comparison to the non-handicapped child. Furthermore, deaf students are still being pushed into stereotyped job roles and dead-end jobs. For the female students it is even a worse problem.

Part of the problem, and the most often used excuse offered by the deaf schools, is that the deaf child needs to spend more time on speech and language development. Hence, Science Education is pushed aside until the upper grades where it is suddenly introduced without the needed foundation to build upón. This is a false and badly used excuse. There is no reason why science cannot be used to develop vocabulary along with language development.

During the author's tour, he found many other problems and excuses being made for the lack of Science Education for the deaf. However, none of these excuses are acceptable, nor are the problems unsolvable, because it has been found that there are some programs that do offer an equal science curriculum to the deaf student. Furthermore, the author himself has developed and implemented a science program at the Rochester School for the Deaf, which is now equal to, and in some cases superior to, science courses being offered in the city's public school.

First let us look at the barriers being placed in the way of the deaf child to avoid teaching them science. Some of the typical excuses brought forth are:

a. Language and speech must be taught first. There is no time for science until high school.
b. Science is too hard for the deaf child.
c. We do not have the equipment and it is too expensive.
d. The daily schedule is fixed, it cannot change to allow a longer laboratory period.

These are but a few of the excuses the author has heard. All of these excuses do not hold up to true facts that have shown that science can and is being taught to the deaf. Going deeper into the problems, we see that the picture is much the same wherever there is a lack of science.

Some of these problems are:

a. The teachers are trained in Special Education but lack a science background.
b. The stereotyped idea that science is too hard for the deaf still is present and thus they tend to turn students away from this field.
c. The lack of laboratory equipment and the fact that the teachers do not know how to build low cost equipment or borrow what is needed prevents the much needed and valuable experience of "hands on" science.
d. The poor communication and lack of support in some schools between the science teachers and the administration results in needed information not reaching the science teachers. Furthermore, in some schools the teachers cannot attend workshops to improve their science teaching skills.
e. The lack of knowledge on the part of the teachers about deaf scientists who have been successful in their field, tends to keep the stereotyped ideas in existence.
f. The lack of a flow of information among science teachers results in a poor spread of information. Many times a teacher in one school has made up a highly successful science course but this does not reach others because of communication breakdown between the schools for the deaf.

In answer to these problems, the author will show how each of these problems can be solved one way or another. Teachers should have the chance to attend workshops, take courses on science and, if possible, work with a deaf scientist to learn the subject. Science, if started in the early years and built up as the student progresses, is no harder than any other subject. We have found that when presented in a stimulating manner the students enjoy the course very much and look forward to each session.

Laboratory equipment does not have to be expensive. Your imagination and some paper clips, tin cans and rubber bands can teach more than the most expensive piece of equipment, which is kept locked up because of fear of breakage.

The administration must realize that science is not a fixed subject, but one that must be flexible enough to take advantage of what is occurring at a given time. A field trip to get rocks or flowers is as much a learning experience as 45 minutes in the classroom. Laboratory work is invaluable, because a child learns by doing and for the deaf child this is double in its value.

Some sort of information exchange should be established so that programs can be made available to all schools and not kept secret in one school.

There are many more excuses and problems. What the author has seen shows why the deaf do not enter the field of science in a larger number. They do not because by the time they reach high school grades, they have not had a science education equal to that of a normal child. When we suddenly dump science on them, without the fundamental building blocks, they are turned off. It is too hard, they do not understand it; they do not like it and will find one way or another of avoiding it. Thus, we end up with students who graduate and follow each other into the same careers one after another. Furthermore, the learning of science teaches the child to think in a logical manner that aides in other courses.

The author refuses to accept either the excuses or the problems. There are some outstanding programs in one or two schools that show that science can be learned by the hearing-impaired. In these schools, we have found students who are interested in entering the field of science.

The Xerox Science Consulting Program and the ESSA program have been used successfully with deaf children. In both cases, the cost of materials is low, because we use the "tin can and rubber band" approach with lots of imagination thrown in.

More important, however, is an untapped source of ideas and help. This is the deaf scientist in your community who has been successful in his field and who would be able to offer the schools methods of teaching never thought of before. These people are invaluable, because they have been through the system, and, have overcome the barriers to a science education.

As teachers of the handicapped, you must rethink your methods, forget the stereotyped ideas that have been in existence so long, and turn to those who will be more than willing to offer their advice and service.

ACCEPTING THE HANDICAPPED

Gregory Stefanich

Everyone needs to be accepted for herself/himself, to be included, and to be allowed to serve as support and inspiration to others. A teacher must be knowledgeable and competent in meeting the special needs of the handicapped. To successfully build a handicapped child's self-image, a teacher must first help other children develop healthy and positive attitudes towards these children.

Orthopedically handicapped persons constantly encounter individuals who react very uncomfortably to them. It is most often a non-verbal expression of avoidance or pity. Much of the reaction is often precipitated by a lack of knowledge and understanding of handicaps. As a seventh grade student who was stricken with polio in 1955, I found difficulty with peer acceptance and peer interaction to be a major problem area.

Science can do much to create a level of understanding through a thoughtfully conceived program which is enjoyable, instructional, and which leads to deeper understanding of the nature of physical limitations. This paper is directed toward providing a greater acceptance and awareness of orthopedic handicaps to educators who have a limited background and understanding of their limitations and compensations.

Goals

1. To provide an understanding of how to deal with and accept differences in people.

2. To promote the acceptance of handicapped children as individuals, more like than unlike the other children, and to encourage their participation in regular group activities.

Definition

The Orthopedically Handicapped child is one who has a crippling impairment which interferes with the normal functioning of bones, joints, or muscles. Included in this category are: (a) children who are born with handicaps, and (b) children who acquire a crippling condition later in life. Examples in each category are listed below:

1. Prenatal handicaps: (a) clubbed hands and feet; (b) abscence of arms or legs; (c) defects in legs, neck or hips;

2. Persons who acquire a crippling condition later in life: (a) poliomyelitis; (b) muscular dystrophy; (c) arthritis; (d) tuberculosis of the bone; (e) osteomyelitis.

Establishing a Classroom Atmosphere

It is important that everyone recognize that how you feel dictates the basis on which you operate. Fellow students must recognize that handicapped children have the same feelings as non-handicapped children and have similar capacities to perceive what others are thinking. This will begin to materialize only after the non-handicapped are sensitized to the needs of the less fortunate. And that will be accomplished only after all children are equipped to live with one another with understanding and appreciation of the differences and disabilities within each one of us. It is important that we mix the abled and disabled together. Separated, the handicapped become isolated and therefore without influence. As a result they often find themselves to be almost totally dependent upon sympathetic but non-handicapped participants in the political process. Acceptance must be learned through showing and helping without indifference, fear or repulsion (Solomon, 1977).

Edward Solomon, a principal at Rachel L. Carson Intermediate School, explains that in helping the physically handicapped the element of mainstreaming must include other handicapped students as well. This will serve to the benefit of all concerned. He states:

> The inclusion of the full spectrum of handicaps was important for both the handicapped and for the normal child. To segregate the disabled child would allow him no opportunity to see another child overcoming a different handicap. Just as keeping him from full participation in a normal school setting deprives the handicapped child of learning to share and to accept and to understand people's differences, so would the exclusion of differently handicapped classmates keep him from a true appreciation of our diversified society. The normal child, who shares his school with students of varying abilities, must learn that there is a population less fortunate than he. Unlike the economically deprived, who can be helped by infusions of money into the schools, these people will always be handicapped, despite all the help they may receive. The normal child must learn to understand, to accept, and to work with people who are in any way limited in body or in mind. Only then will the normal majority come to accept their responsibility for providing for the handicapped on the basis of need rather than seeking ways of keeping them from entering and participating in the larger society (1977).

Attitudinal barriers associated with guilt and avoidance by normal persons and adaptive manipulative behaviors by physically handicapped must be dealt with effectively in classrooms. Attitudinal change can best be initiated through providing appropriate models who project warmth, open-mindedness, fairness, and a real concern for each child.

The problem is not only one of children accepting the handicapped, Soloman points out that it is also a problem for the professional educator: He states:

> The regular teachers were fearful. Some were repelled. Some were anxious because of feelings of inadequacy. Some provided generous doses of pity but little understanding or acceptance (Solomon, 1977).

As a student with a mild orthopedic handicap during my Junior High School years, I can certainly relate many direct experiences which illustrate this point. I found that by careful manipulation I could avert most of my school work. Because I was attending a physical rehabilitation program two or three days a week in a neighboring community, I was able to forestall most homework assignments. My school days consisted primarily of taking tests and incidental involvement within the rest of the instructional program. Being a fairly strong academic student the teachers simply overlooked the idea of homework and allowed the tests to reflect my grades, often more generous with grades than my test performance reflected.

As a result I often feel there are voids in my academic training during my junior high school years which handicap my performance yet today. Fortunately, during the ninth grade, I can recall two teachers who maintained an attitude of eager and positive acceptance, yet not only expected but demanded a full effort on my part.

As a professional educator, I feel strongly that all teachers and administrators should have training in both areas of regular and special education. Only then will there be a balance between realistic expectations from the teachers accompanied by full participation from the handicapped student. Teachers must be made to realize that essentially every act that a person makes is, from his perspective at the time it occurs, the most appropriate response he can make to the stimulus to which he is responding. A student then when misbehaving is doing what seems to give him, at that moment, the greatest degree of psychological comfort (Kindsvatter, 1978).

Teachers often tend to justify inappropriate student performance by imposing a failing grade. What we fail to realize is that the failing grade is often a major obstacle to increased student responsibility, and is frequently manipulated by the handicapped to avoid effort. The handicapped student becomes astute at shifting the responsibility from him/her to the teacher. The student in order to protect his ego, claims he was not given a fair chance. The teacher in turn compromises his conscience and gives a passing or satisfactory grade out of pity or sympathy (Johnson, 1978). The child begins to learn that behavior has no consequences and through manipulation of others, he/she can ignore responsibility and consideration for other persons.

Hopefully, the mandate of P. L. 94-142 requiring that local school districts develop an individualized educational plan for every handicapped child will alleviate many of these past deficiencies. It can serve as a planning system and monitoring device to enable the administrators, teachers, parents and child to work towards certain goals. This development of skills which will enable the handicapped child to function effectively as an independent adult and productive member of society cannot be overemphasized. If we are indeed preparing handicapped children to function in the real world, the need for mainstreamed education is critical. Iris Kizer, principal of the Alexander Graham Bell School for hearing impaired children in Cleveland, Ohio states:

> Better they work it out in the classroom among friends than to get on the job and discover they have these problems (Cole, 1977).

It is impossible to describe appropriate teaching roles for an individual child, as each child is unique and adaptive behaviors will be different for each child. However, there are a few general considerations which teachers may find helpful.

1. Provide experiences in which the child can achieve success. If expectations become unrealistic the teacher does not discipline the child for what he does, but for what he is.

2. Emphasize what the individual can do.

3. Perceive the person's basic self-worth.

4. Allow handicapped person to play an active role in planning and living his life.

5. Value even minor accomplishments, and not necessarily because they will meet or exceed a norm.

6. Realize the visibility of the condition.

7. Provide assistance to disabled without demeaning them.

Responsibility to the Orthopedically Handicapped Student

All individuals grow and develop as a result of experiences, relationships, thoughts and emotions. Virginia Axiline states the following:

> The child must first learn self-respect and a sense of dignity that grows out of his increasing self-understanding before he can learn to respect the personalities and rights and differences of others. The child must experience himself as a capable, responsible person in a relationship that tries to communicate to him two basic truths: (1) that no one ever really know as much about any human being's inner world as does the individual himself; (2) that responsible freedom grows and develops from inside the person (1964).

Physically handicapped students must be brought to perceive a basic self-worth. The child must be made to realize the visibility of his/her condition and the fact that, for most physically handicapped, the visibility will affect his/her interactions with other people throughout life. The individual must be made to understand that acceptance is a slow, continual process and if he/she is to be successful it is necessary to play an active role in planning future goals.

Not So Different

It should be stressed that the Orthopedically Handicapped child is generally not affected in the way he learns. The adjustments necessary are physical rather than educational. There is probably no greater dejection for a handicapped person than to begin to engage in an activity only to have a normal person intrude and do it for him/her. It should be stressed in helping the physically handicapped that patience, rather than assistance, is needed. The school should assume responsibility for providing an environment which allows the Orthopedically Handicapped to be as independent as possible and to promote freedom of movement and physical activity. In addition to the modifications necessary in the gross physical environment, the teacher should always look for ways to provide aids and devices which can assist the child in functioning independently. Because of the heterogeneity of crippled individuals it is impossible to describe devices appropriate for an individual child.

Many compensations can be made by providing the orthopedically handicapped with special equipment which allows them to function independently. Some of the more common items are: (a) book racks for children who cannot hold books; (b) ceiling projectors for children in bed in hospitals and/or home; (c) electric typewriters; (d) automatic page turners and pencil holders ([illegible], 1972). An effort should be made to secure equipment similar to those listed and also other prosthetic aids for locomotion, life support, personal grooming, communication and household aids. Many such aids are explained and illustrated in Smith, 1975.

Like all children, the crippled have certain hopes and aspirations which affect their behavior. However, because their means of satisfying them are more limited, we must determine ways to help them find realistic ways to meet their needs. Once they meet success they are more likely to be objective toward their physical handicaps and accept their limitations.

Kirk (1972) states the following:

> Because of the child's inability to gain a normal feeling of security and because he has often been over-protected at home, there is a tendency to rely on the protectiveness of other people and to prolong his dependency.

It is far better to work at developing physical devices that will facilitate self-sufficiency than to attempt to meet their needs through assistance. Attitudes towards each child's personality and adjustment is extremely important. We must not only be sensitive to meeting the physical needs, but must also help motivate the child who is depressed and withdrawn, and accept the child who sometimes displays emotional outbursts.

Educators must assume responsibility for the development of the total person. Academic achievements are only part of a total education. Learning to live together, learning how to communicate, discovering attitudes and values, learning acceptable social behavior, and learning to accept others are as important. Most importantly we must be a living example to the student, projecting warmth, open-mindedness, fairness and a real concern for the life of each child.

References

Ashcroft, C. S. Handicapped in the regular classroom. NEA Journal, November 1967, 56.

Axline, Virginia M. Dibs in Search of Self. New York: Ballantine Books, 1964.

Hill, Mildred G., et al. The Development and Implementation of a Minimum Objective System in the Hinesburg Elementary School. Washington, D. C.: Bureau of Education for the Handicapped, January 1975.

Johnson, Christopher. Secondary schools and student responsibility, Phi Delta Kappan, January 1978, 59.

Kindsvatter, Richard. A new look at the dynamics of discipline. Phi Delta Kappan, January 1978, 59, 322-325.

Kirk, Samuel A. Educating Exceptional Children. Boston: Houghton Mifflin Co., 1972.

May, Waggoner, and Hotte. Independent Living for the Handicapped and the Elderly. Boston: Houghton Mifflin Co., 1974.

Mayer, Colleen. Understand Young Children: The Handicapped Child in the Normal Pre-school Class. Anchorage, Alaska: Treatment Center for Crippled Children and Adults, July, 1974.

Miller, Rozelle J., et al. Teachers' Guide for Exceptional Children and Youths. Washington, D. C.: Bureau of Education for the Handicapped, May 1975, 47-48.

Pieper, Elizabeth J. Preparing children for a handicapped classmate. Instructor, August/September 1974, 84.

Smith, Robert M., and John T. Neisworth. The Exceptional Child: A Functional Approach. New York: McGraw-Hill, 1975, 235-255.

Solomon, Edward L. New York City's prototype school for educating the handicapped, Phi Delta Kappan, September 1977, 59, 7-10.

PANEL II: CURRENT PRACTICES RELATING TO ALL PHYSICAL HANDICAPS

Participants:

Bennett F. Berhow	"A Kindergarten Science Program for Handicapped Children: Adapting Existing Curricula"
Carl Fenn	"Science Education in a Woodland Setting: A Program for the Handicapped"
E.C. Keller	"Experiences with Multiple Types of Handicapped Pre-College Students in an Integrated Marine Science Field Program"
Dennis Schatz	"The Role of the Science Museum in Science Education of the Handicapped"

Reactants:

Donald W. McCurdy	"An Integrative Model for Preparing Regular Classroom Teachers to Work with Handicapped Students in Science"
Deborah Ann Swazuk	"Mainstreaming Physically Handicapped Students"

John Schaff, Chairperson

A KINDERGARTEN SCIENCE PROGRAM FOR HANDICAPPED CHILDREN: ADAPTING EXISTING CURRICULA

Bennett F. Berhow

The development and implementation of a science curriculm for thirteen handicapped kindergarten students will be described and evaluated in this paper. The purpose of this discussion is to illustrate the successful adaptation of existing science materials, to posit some of the limitations and difficulties and to make recommendations concerning the adaptation of existing science curricula to meet the educational needs of handicapped children.

The planning and teaching summarized in this paper was done by Ms. Debbie Foughty, a senior elementary education student at the University of North Dakota (UND), Grand Forks, North Dakota. Ms. Foughty planned and taught the described sequence to fulfill the required work in an independent study in elementary science that was taught by the author of this paper. Ms. Foughty does not have a very extensive content background in science and chose to undertake the learning task in an effort to improve her science teaching competence.

The author and Ms. Foughty initiated the planning task by discussing the possible functions of the science curriculum in the anticipated program for handicapped kindergarten students. The functional definition of science for the purposes of identifying an instructional sequence focused upon manipulative experiences that emphasized children exploring their world with imagination and curiosity. Discussions of cognitive expectations emphasized using the senses and the development of vocabulary that would help children more precisely communicate their observations of their environment. Resources of science activities to assist in the instructional planning were located in the author's personal library and the university bookstore. The non-science resource materials and instructional materials were located in Sweetwater Elementary School.

The science curriculum described in this paper was developed to meet the needs of a very small group of students in a very unique educational circumstance. The conclusions and recommendations offered should be viewed within the framework of these environmental constraints and limitations.

The kindergarten for handicapped children was located in Sweetwater Elementary School, Devils Lake, North Dakota. Devils Lake is a community of 7,000 people located in central North Dakota and is 100 miles from the University of North Dakota. The public school system has three elementary schools, one junior high school and one high school that serves 2,000 students. Sweetwater Elementary School, with 252 students, is the smallest of the three elementary schools. Kindergarten is not required by state law and the Devils Lake school district, as is typical in North Dakota, does not support a regular kindergarten program for all children. Parents must send their children to private institutions if they desire a kindergarten experience for their children. The kindergarten for handicapped children at Sweetwater was financially supported through the school district and served the entire Devils Lake community.

All children in Devils Lake are screened for handicaps during the spring preceeding their enrollment in first grade. This does not occur early enough in the year to permit enrollment in the kindergarten program for handicapped children. Most parents who enrolled their children in this second special kindergarten heard of the program by word-of-mouth and it was the parents who decided if their child should be included in the special kindergarten. Some of the children had handicaps that were diagnosed by professionals; many were placed in the class because parents believed the program was needed by their child.

Five of the children had hearing impairments. One child's impairment was severe enough to require a hearing aide and the child's impairment may be severe enough to require some schooling at the North Dakota School for the Deaf in Devils Lake. The hearing impairment of the other four children was not severe enough to require a hearing aide, but the hearing impairment did seem to have some effect upon speech development.

Three of the children had sight impairments. Two of the children suffered amblyopia that was being treated by a physician and required them to wear patches over an eye. The third child's sight problem, although limiting, was not precisely diagnosed and was not being treated by a physician. The children being treated by a physician have eyesight that is greatly diminished and the eyes of the child not being treated are apparently lazy.

The other children in the classroom suffered from a multitude of other impairments. Two children were receiving physical therapy because of muscular difficulties. The remainder of the children suffered developmental impairments that were evidenced as poor motor skills and coordination, language impairments and learning disabilities.

Sweetwater Elementary School uses Elementary Science Study (ESS) materials as its science curriculum. Ms. Foughty, who planned and taught the described science curriculum, had used some of the ESS materials and decided to search other resources for appropriate science activities. She wanted an integrated program of art, music, language arts, science, math, and even cooking, and felt that individual activities rather than units were more suited to her needs. A bibliography of resources for science activities is provided with this paper. Other classroom non-science teaching resources and materials, such as the Peabody Language Kit, music books, literature books, etc., that were regularly used in the classroom are not listed in the bibliography.

As part of the total learning program design, Ms. Foughty synthesized a set of learning outcomes that were to be achieved through child participation in selected science activities. The cognitive and developmental outcomes, as objectives, are listed below.

1. Interpret sensory stimuli by:
   a. using the senses to describe and identify objects hidden in a sack.
   b. identifying the taste and the name of food when blindfolded.
   c. distinguishing between salt and sugar.
   d. describing the size, color and shape of objects while playing a game.
   e. making sounds using their mouths and selected objects.

2. Demonstrate visual awareness by identifying shapes--square, triangle, circle and rectangle.

3. Demonstrate listening awareness by differentiating sounds as:
   a. loud-soft
   b. high-low

4. Identify the seasons by:
   a. identifying activities associated with each season.
   b. identifying clothing that is worn during each season.

5. Experience spatial relationships between self and the environment (full to the top, over, under, etc.)

6. Perceive size as an attribute which is both concrete and relative by:
   a. comparing the height of the children.
   b. serializing buttons by size.

7. Recognize the characteristics of liquids by:
   a. describing what way water pours.
   b. identifying objects that float in water.
   c. describing what happens when materials such as salt, flour, food coloring and syrup are added to water.
   d. describing what happens to ice when it gets hot.

8. Identify shapes of circle, square, rectangle and triangle in the environment.

9. Recognize various aspects of weather by:
   a. identifying how a kite flies.
   b. identifying what is melted snow.

10. Group and classify buttons according to attribute identified by the student.

To illustrate the type of science activity used and its integration with other components of the kindergarten instructional program, a specific instructional sequence is provided below. The example instructional sequence is Ms. Foughty's lesson plan for one week which she wrote, taught and sent to the author.

General Instructional Objective: Perceive size as an attribute which is both constant and relative.

Activity 1: Compare height of all children. Tape a long piece of paper along the wall, one side touching the floor. Have the children stand, one at a time, with their back to it to be measured. Write each child's name on the line that indicates his height.

When finished, ask: Are you all the same size? Which ones are shorter? Which ones are taller? Why are some bigger than others? Are older people bigger than children? Why? Will you stop growing taller some day?

I then measure myself on the chart to show that adults are taller. Ask: Do you know some adults taller than I am? Why do some people grow taller than others?

Have children arrange themselves from short to tall. Then ask them to reverse the order.

Label objects around the room using terms regarding size.

Activity 2: Grouping and classifying buttons, to develop skill in observing, grouping and classifying.

Give each group of two students a handful of assorted buttons and ask them to make two groups that are alike in some way.

Next, ask them to reassemble the buttons into three groups. There will be no right or wrong responses. Ask them to explain what they have done.

Have them serialize the buttons in a line from small to larte.

Have them make various shapes using the buttons.

Activity 3:

Read - "The Big Radish" by Maria Robbins

"Big Dog...Little Dog" by P.D. Eastman

Read - "Tall and Short" poem by Big Bird and Little Bird.

Activity 4:

Have children make cookies with Cookie Monster again. Have each child only make two cookies--a very large one and a very small one. Discuss.[1]

The evaluation of the success of the science instructional sequence in the kindergarten program focused upon observing the behavioral changes of the children. Ms. Foughty is trained in classroom observation strategies as a learning evaluation tool. In addition, portions of classes were video-taped and sent to the author for observation. The following discussion of behavioral changes of the children is based upon observational data gathered by Ms. Foughty and the author.

At the beginning of the semester many children exhibited very limited attention spans. They were able to effectively function in a

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[1] Ms. Foughty's complete sequence of planned science lessons is available upon request from Dr. Bennett F. Berhow, Education Building, Room 105, University of North Dakota, University Station 179, Grand Forks, North Dakota, 58202.

group setting for only a short period of time and they then withdrew from the group activity, both physically and functionally. This was particularly a problem for two of the children. One child would withdraw from the group and seek "mothering" from an adult. The other child would withdraw from the group and engage in physical activity with much jumping, twirling and hand shaking.

There were other behaviors observed that interfered with maximum functioning in a school environmnet. Many of the children seemed timid and unsure of themselves and needed extensive, detailed directions and close supervision. Many of the children also exhibited some language difficulties. Mispronounced words and incomplete sentences characterized much of their language behavior.

By the end of the semester all of the children were able to complete a science activity without withdrawing from the group. In addition, the children demonstrated an ability and eagerness to initiate and control the processes in which they were engaged. Ms. Foughty was not required to give frequent and detailed directions for completing investigations. This increased self-discipline also seemed to help the students become more relaxed and comfortable when manipulating materials. For example, they became less anxious or concerned about spilling materials on the floor or making a mess on the tables.

The language development of the children was particularly marked. Many new words were added to their vocabulary but the most significant change in verbal behavior seemed to have occurred in group activities. The amount of interaction greatly increased with questions being asked and observations being verbalized. The amount of

verbalization of each child increased and the number of people the children interacted with increased. The interaction increase was noted among the children and between the children and the adults.

Based upon the observations of Ms. Foughty and the author, the following conclusions concerning the success of adapting existing science curricula to meet the educational needs of physically handicapped kindergarten children were formulated:

1. The children enjoyed the science activities and looked forward to their "science time" with great anticipation. "Science time" was the last activity of the school day and the children verbalized an eagerness for the time to begin.

2. The children were able to develop self-discipline skills in a schooling environment that should better their chances for success in first grade. Most of the children will enter a regular first grade classroom the following year.

3. The self-concept of each child was enhanced because the science activities provided every child an opportunity to have success in a school setting.

4. The teacher was able to change from a teaching behavior that controlled all activity to a more facilitative style.

5. Skill development of the children required in the speical education guidelines and reports of the teacher of record was achieved by participation in the science activities. Vocabulary and motor skills specifically listed as learning objectives in the special education guidelines were particularly enhanced.

The following conclusions concerning the difficulties of adapting existing science curricula to meet the educational needs of physically handicapped children were formulated:

1. Adaptation requires extensive planning effort by the teacher. This is particularly true when the science curriculum is integrated with the other curricular components of the school program.

2. The mandated curricular time requirements of many state and federal program guidelines for physically handicapped children, particularly in the language arts, make the scheduling of science activities difficult and not meeting the required time constraints may often endanger program funding.

Based upon an analysis of the conclusions in this paper the author recommends that:

1. Existing elementary or early childhood science curricula be modified for physically handicapped children and implemented on an experimental basis. Evaluations of such adaptations should primarily focus upon student development, cognitively and attitudinally, and upon observed student response to the curriculum.

2. Support systems be developed to assist teachers in the adaptation process. The effort required to effectively design and implement an elementary or early childhooe science program for physically handicapped children probably cannot be expected as part of daily teaching activities required of teachers in typical teaching-learning processes.

Bibliography

1. Day, B. Open learning in early childhood. New York: MacMillan, 1975.

2. Harlan, J.D. Science experiments for the early childhood years. Columbus, Ohio: Charles E. Merrill, 1976.

3. Munson, H.R. Science activities with simple things. Belmont, California: Fearon, 1972.

4. Playmate magazine.

5. Project self-discovery. Educational T.V.

6. Reid, R.W. Science experiemtns for the primary grades. Belmont, california: Fearon, 1962.

7. Schmidt, V.E., and V.N. Rockcastle. Teaching science with every-day things. New York: McGraw-Hill, 1968.

8. Spencer, Z.A. 150 plus! games and activities for early childhood. Belmont, California: Fearon, 1976.

9. Throop, S. Science for the young child. Belmont, California: Fearon, 1974.

SCIENCE EDUCATION IN A WOODLAND SETTING
A PROGRAM FOR THE HANDICAPPED

Carl Fenn and Donald K. Hamilton

Handicapped children are unique individuals with no two being exactly the same. But like all of us, each one has a peculiar combination of abilities and disabilities which are constantly in the process of changing as the individual grows and learns. Unfortunately many have disabilities which inhibit their opportunities to explore the great outdoors. Children confined to wheelchairs ordinarily cannot take a simple walk in the woods to enjoy its sights or to explore and discover that world which is so distinctly different from the confinements of a house. Visually impaired children do not receive the visual stimulation to explore a flower garden or the world of animal life to be found at the top of the trees or crawling through the ground in the woods or a pasture. The thrill of discovering this world creates an excitement for learning which cannot be duplicated in a classroom.

How could a school provide these kinds of experiences for handicapped children, thus meeting the mandate of providing an "appropriate education" for all handicapped children as required by Public Law 94-142? The need for a woodland setting in which an educational program could emerge to accomplish the following objectives was evident:

(1) To stimulate language and motor development.

(2) To encourage the use of their senses in teaching, listening and observing.

(3) To advance their basic science concepts pertaining to plant and animal life.

(4) To learn to preserve our natural resources through thoughtful care and management.

(5) To gain an appreciation and enjoyment of the out-door environment.

(6) To develop hobbies which will provide constructive use of their leisure time.

Behind the Eugene Field Elementary School in Rock Island, Illinois is a ravine. It required policing to control for motor bikes and refuse disposal. Recognizing that this ravine had the potential to be developed into an outdoor learning laboratory for handicapped children, work was initiated during the Summer of 1975 with supportive funding from a Title III ESEA grant. Concrete walkways from the school to the woods were constructed with raised beds of plants and flowers along side to enable children confined to wheelchairs and those who are partially sighted to learn about nature by being close to it.

More than 400 volunteer hours were given to the project by such diverse groups as children who attended the school, professional builders, the lady next door, and the boy who often used the woods for trails to ride his mini-bike. The imagination of the community was captured into developing a resource to be used in educating handicapped children.

The special children at Eugene Field Elementary School required a program that reflected an amalgamation of the thinking and planning of the science educator, the special educator, the curriculum evaluator, and the classroom teacher. A team representing these various int[illegible]st areas was assembled to prepare the curriculum materials for the program. The March 1976 issue of Science and Children identified a number of ways of involving the handicapped in the outdoor environment.[1]

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[1] Lombardi, Thomas, P., and Blach, Patrick E., "Science Experiences and the Mentally Retarded", Science and Children, Volume 13, Number 6, March 76, p. 20.

The approach of the writing team was to prepare activities that utilized the child's senses in developing an awareness of the woodland environment. As the child became aware, sequential activities called for higher level skills of classification, communication, measurement, vocabularly development, predicting, inferring, and experimenting. A Curriculum Guide was prepared including sample activities which would be used on site, instructions for teachers for scheduling and using the site, and materials that were available at Eugene Field for doing the investigations. The variety of activities included "Awareness Along the Trail", "Listen and Hear", "Studying the Soil", "Animal Signs and Tracks", "Trees in the Ravine", "Leaves", "Getting Bugged", "Temperature, Wind, and Humidity", "In the Snow", and "Hobbies From Experiences in the Ravine".

With the completion of the curriculum guide a center was established at Eugene Field. The center housed sets of materials that were required for the activities on site. Copies of the guide were distributed to the schools in the city, and scheduled visitations to the site were arranged through the center staff. These visits were coordinated with the on site usage by the handicapped providing many mainstreaming opportunities. For many of the handicapped children it was their first opportunity to experience a woodland environment. To be lifted out of the wheelchair, and laid on the ground, to feel the dew, to smell a flower, to be stuck by a thorn, to catch a bug, to caress the soft green moss was an experience of lasting and endearing value. Reactions included hesitancy; a look of concern, happiness, an exclamation of joy, pleasure; a smile, a laugh, interest; careful examination and questions and more questions; sharing; "look at mine".

Operation of the site was to include visits by regular science classes through-out the district which provided an excellent opportunity for mainstreaming the handicapped with other children. As the teacher scheduled a visit with a regular or handicapped class she was given an evaluation check list which was left at the end of the day. This process of continuous activity evaluation provided a mechanism for modification of the program based on users recommendations.

SAMPLE OF ACTIVITIES IN A WOODLAND SETTING FOR THE HANDICAPPED

Title: Awareness Along the Trail

Materials: No particular equipment is provided for this activity, but one should examine the trail to make sure that he will find some of the suggested items.

Rationale: A walk through the ravine can be more than a "bunch of trees, bushes, weeds," but often it is necessary to point out to children the richness of the environment, and this activity should be done prior to any structured experience in the ravine.

Objectives: After this activity the child should be able to:

1. Describe the characteristics of a woodland trail.
2. Identify three different smells along the trail.
3. Identify at least five different sounds heard along the trail.
4. Give some of the history of the region.

Procedure: Sensory Awareness Trail

1. Close your eyes and examine the bark of this tree by touch alone.
2. What descriptive words would you use to describe the texture?
3. Stop for a quiet moment by the brook, listen.
4. What sounds do you hear?
5. Dip your hand in the water. Does it feel warmer or colder than the air?
6. Can you estimate the temperature of the water?
7. Close your eyes and listen again. Can you hear different birds?
8. How many kinds of bird calls do you hear?
9. Examine the leaves on this tree.
10. Can you sketch the veins? How would you describe them?
11. Is the leaf compound or simple?

Procedure: Sensory Awareness Trail (Continued)

12. Is the leaf margin smooth or scratched?
13. Look around you. Is this virgin timber? Has it always been timber? Are all the trees the same age? How many different kinds of trees do you see from where you are standing?
14. Look at a dead log. How old was the tree? Can you tell the wet years from the dry years? Was the log a part of the trunk (stem) of a tree or was it a branch? If it was a branch which side was up? Which years would be good rabbit years? Crush one of the leaves. Smell it. How would you describe the odor? Smell a handfull of humus. What does it smell like?

Observation Trail: Describe this flower. What does it look like to you? How many petals? What color are they? How are the leaves arranged on the stem? Have the flowers gone to seed? Describe the seed. Examine the bird-feather, note its color and size. Describe the location where you found it. Does this location where you found it give you any hint as to the type of bird? Can you guess from what bird this came from?

Problem Solving Trail:

1. Can you figure out what animal has been here?
2. What clues can you find? (Evidence of footprint, fur or feathers left behind).
3. Can moss on a tree be relied on as an indicator of direction?
4. Does moss always grow on the north side?
5. Check this out on at least 10 different trees to see if the theory holds true.
6. If you were lost in the woods and had to live off the land in this area for several days, which plant would you select as a source of food?

Skills Involved: Auditory discrimination, auditory memory, visual discrimination, visual memory, tactile discrimination, language development, motor development.

Age Level: 3 to 12

Title: Animal Signs and Tracks

Materials: Vary with the conditions. Many of the animals in the area are seldom seen by the student. They may be nocturnal and/or very timid. The tracks and signs they leave behind give us clues to their behavior, size, range, etc. The art of tracking, so highly developed by the American Indians and the early frontiersmen is a fascinating activity.

Objective: To practice the powers of observation and deduction from natural evidence.

Procedure:

Activity 1: (a) The first task is to find some tracks. The ease of the task depends somewhat on the season. When there is a soft snow on the ground you will have little problem of finding tracks. During drier times of the year, you will have to look for moist spots or even have to prepare a spot and bait it. Dusty spots are also good, even in the drier weather.

(b) Once the tracks are located:

1. Can you determine what was the animal doing; running, sitting, walking? Did it change pace? What direction did it travel?

2. Did it make anything; burrow, bed, house?

3. Did it leave anything; droppings (scat), wing marks, bits of fur or hair, pellets, tooth marks, open nuts?

4. Identify the tracks, which are the forefeet, what is the length of the track, and the length of the stride?

(c) Prepare methods of preserving the tracks. The methods you use depends on the surface the track was made in.

1. Methods - sketching, plaster casts, wax casts, mud casts.

2. Surfaces - mud, snow, wet sand, dust.

3. Directions for marking casts.

Activity 2: Making a Plaster Cast

Equipment: Strips of cardboard 25 cm in length, 5 cm wide - these may be cut from manila folders of tagboard

Paperclips
Water
Plaster
Mixing can and spoon

Procedure: 1. Carefully clean the surface around the track of debris.

2. Form a circle around the print with a cardboard ring and fasten it with a paperclip. The ring may be slightly pressed into the soil for support.

3. Mix the plaster according to directions on the bag or can. The consistancy should be like soupy ice cream or pancake batter.

4. Pour the plaster into the ring until the print is covered.

5. As the plaster is setting, insert a paperclip along the cardboard ring at the top of the print. Later when the plaster dries, the paperclip may be bent out to use as a hanger for display purposes.

6. Tap the edge of the cardboard to dislodge any bubbles.

7. Allow the mold to set until hard (at least 15 minutes). The drying process may be speeded up by adding salt to the plaster, or slowed down by adding vinegar.

8. When dry, carefully lift out the mold, remove it from the cardboard and clean off the debris.

Snow Casts: 1. Spray the track with a fine mist of water. This spraying should build up a layer of ice in the track.

2. When mixing the plaster, add some snow to lower the temperature of the plaster to avoid melting the print.

Dust Prints: 1. This operation is harder and the reproduction will not be as good as those on other surfaces. The procedure is the same except that the print is carefully sprinkled with salt.

2. Just before the plaster starts to set, pour it to one side of the paper ring and let it flow down into it.

Variations: If no prints are available and you want the children to learn the techniques of making plaster cast, a footprint of the child may be substituted.

Another variation is using nature objects the group collects on a hike. The procedure is the same as above, except that the plaster is poured into the ring, let it harden slightly, the objects are pressed into the top of the plaster and removed, leaving their outline and texture.

Skills Involved: Motor development, visual discrimination, visual association, measuring.

Age Level: 7 to 12. May not be appropriate for visually handicapped.

Title: Listen and Hear

Materials: 1 cassette recorder for every 5 children

Rationale: Children are often taught to block our external sounds i.e. to concentrate only on the teacher's voice. This practice tends to restrict the development of the sense of hearing rather than expand it. In this activity the children will be given an opportunity to expand his sensual awareness by concentrating on all sounds in an outdoor environment.

Objective: At the end of this activity the child will be able to:

1. Identify five specific sounds heard when walking down a nature trail.

2. Identify five sounds he turned-out from a given environment.

Procedure: Take a group of four or five students on a ten to twenty minute excursion through the ravine. Be sure to have a portable cassette recorder with you. As the group leader make sure the others experience a variety of sounds. If necessary make sounds by dropping rocks, logs, etc., but do not reveal what you are doing. No talking should take place on the trip while the group observes anything that interests them.

At the completion of the trip have each child list all of the sounds he can remember hearing. Play the tape and as the group identifies a sound list it on a separate chart. Each child should then list on his chart the sounds he missed.

Evaluation: Play a short tape of selected sounds. While the child is listening make a variety of sounds in the background. How many sounds can the child identify? How many sounds did the child "tune-out"? Why did this occur?

Skills Involved: Auditory discrimination, auditory memory-recognition of sounds of nature. Auditory association-vocabulary development.

Age Level: 3 to 12

Title: Hobbies From the Ravine

Rationale: A day in the ravine can suggest a variety of hobbies or special interest areas that the child may wish to persue after returning to the classroom. Outlined in this activity are a number of interest areas that individual children may want to explore in greater depth.

Procedure: I'm a Weatherman

Children may wish to visit the Quad City Weather Station at the airport. Here they will find people willing to share with them the life of a weatherman, they will see how records are made and kept, and can learn to set up a weather station at school or home. Records kept through-out the year can be kept and shared with children in next year's class. Stories can be written and told about the effect of local weather conditions on man.

I'm an Ornithologist

Children will have discovered a variety of bird life while in the ravine. This interest can be expanded to school, home, meadow, forest, river, or city street. Illinois is blessed with an excess of 300 species of birds. In addition, many birds visit Illinois briefly as they migrate along the great Mississippi flyway. Children can begin to study birds by watching their feeding, nesting, and housing patterns. These studies can then be expanded to rarer birds. Calls can be learned so that recognition can come without sight. Each bird has characteristic field markings which the child can utilize for identification at great distances. Environmental requirements for certain specific species of birds can be identified which can lead to a lifelong interest in the preservation of endangered species.

Seeds - A simple but interesting activity can be accomplished by coloring samples of bird seed with food coloring. The samples are then placed at the feeding station and children can keep a record of the color of seed the birds prefer.

Nest - Bird nest can be collected. Make sure the birds are through with them. Measure, weigh, and classify according to design and building materials.

I'm a Craftsman

Wooden trinkets have long been a favorite of man, furthermore, in constructing objects from wood the child has an opportunity to develop a variety of skills. The activity which follows can begin a life-long interest in working with wood.

Obtain small branches 3 cm or less from several varieties of trees such as oak, walnut, osage orange (hedge), cherry, apple or any of the pines. Carefully cut a cross section from the branch so that each slice is no more than one centimeter thick. The children need to be given an opportunity to examine slices from a variety of trees. Note the rings, the texture, the color, and the smell. Obtain an assortment of sandpaper and let the child discover which type gives him the smoothest finished product. A variety of finishes can be used such as oil, varnish, lacquer each providing different characteristics to the wood. Let the child experiment with the combinations of wood, sandpaper, and finish to give him a final product he desires. He then may suggest ways of using his product and ways of mass producing more like it. The whole concept of production and assembly can be explored with suggested field trips to area plants where mass production is a way of life.

I'm an Entimologist

Insect studies in the ravine are limited to the day or days the site is visited. As the seasons progress, a constant progression of insect species become available for study. The child may become curious enough to start a collection. The activities which follow suggest ways of killing insects.

The Killing Jar: Obtain a large opened mouth jar wide enough to hold a large butterfly without crushing its wings. Mix up about half a cup of plaster of Paris and carefully pour the mixture into the jar so that it does not splatter on the sides of the glass. Let the plaster set for an hour, then add a few drops of insecticide allowing it to soak into the plaster. Close and label the jar POISON.

When adding the insect, remove the lid and quickly transfer the creature to the killing jar. Close the lid and wait about 20 minutes. After using the killing jar several times it may be necessary to add some additional insecticide.

Displaying the Insect:

Baby Food Jar: Label the insect by placing a pin through the body of the insect and then through a strip of paper on which you have printed the name of the creature. Glue a cork to the inside of the baby food jar lid, mount the insect and pin in the cork and screw the lid on the jar.

Cigar Box: Glue a cork to the bottom of the box and place the mounted insect on the cork. After mounting a number of insects, cover with clear plastic and seal the edges.

I'm Botanist

The plant kingdom of the ravine can spark the desire to grow plants in the classroom or at home. A number of activities are suggested.

From Seeds: Examine a variety of seeds such as beets, peas, beans, lettuce, corn, pumpkins-weed seeds - nuts (hickory, walnut, peanut, or acorns). Try and set-up a classification key similar to the one suggested in the insect study. Characteristics that might be included are length, width, weight, color, shape, and the nature of outer shell.

Examine mature plants, can you locate the seeds? How are the seeds protected? How are they distributed? How many seeds are there on one plant?

Germination: The following variables can be explored:

a) Amount of water
b) Temperature
c) Soil characteristics
d) Light
e) Presence of pollutants (detergent, herbicides, pesticides)

Plant Growth: As the seeds germinate mature plants can be grown and again a variety of experiments can be conducted looking at the following variables:

a) Light
b) Water
c) Temperature
d) Color of light (Use different colored plants)
e) Spinning vs. still plant
f) Fertilizers

More Seeds: As the plants mature they will produce seeds which can be used for successive generations studies. Some questions that might be explored:

a) Does an albino seed produce an albino plant and are successive generation seeds albino?
b) Does a seed from a tall plant produce a tall plant?
c) Will popcorn and corn cross fertili[illegible]
d) Does a hybrid plant produce fertile seeds? Do the seeds have the same characteristics as the parent?
e) Can you find a seed that has to be frozen before it will germinate?

Cuttings: Some plants do not produce seeds but grow from roots or from cuttings. Find samples and try your success at producing these plants.

Skills Involved: Visual discrimination, visual memory, language development, classifying, labeling, measuring.

Age Level: 3 - 12

Experiences with Multiple Types of Handicapped Pre-College Students in an Integrated Marine Science Field Program

E.C. Keller, Jr. and Helen E. Keller

Several years ago, while conducting pre-college summer programs in the life sciences, it was observed that few, if any, handicapped students occurred among the final set of selected participants. Selections of these students were based on several attributes such as: Sequential Testing of Educational Progress (STEP) scores, science course grades, Pre-Scholastic Aptitude Test (PSAT) scores, IQ level, etc. along with other aspects that the students presented (for example, samples of writing, reasons for wanting to attend the program, their past year's reading list, etc). Little attention was given to the fact that there were only one or two handicapped participants. None of these handicapped participants was severely handicapped. All were slightly or moderately handicapped. During an evaluation of the summer biology pre-college programs for outstanding students at West Virginia University (Keller, et al. 1977) it was confirmed that there were, indeed, extremely few handicapped participants. Following that initial review, a survey was conducted in 1975 of the 110 Student Science Training (SST) programs for outstanding pre-college students funded by The National Science Foundation. The objective of this survey was to asertain the proportion of handicapped participants in the various NSF/SST programs. The results of this latter survey showed that there was a 16 to 20 fold deficiency (1) in handicapped participants as compared to the proportion of handicapped individuals in the general population. It was noted however, that the reason for the deficiency was not due to the selection process of the various SST programs, but was due to the fact that very few handicapped students applied for positions in the programs.

With these observations, and with certain other pieces of information, a proposal was submitted to The National Science Foundation requesting support for a special program in the Marine Sciences for outstanding handicapped pre-college students. The program, funded by NSF, was to be carried out at the Marine Science Consortium's Wallops Island, Va. facility, and was for blind, deaf, and orthopedic handicapped students. The program was successfully concluded on July 29, 1977 with 23 handicapped participants completing the program. The program started with 24 participants, but one of the severely handicapped orthopedic participants returned home on the third day.

The primary objectives of this project were to introduce outstanding handicapped pre-college students to Marine Sciences, to directly interface these handicapped students with college faculty, and to assess the success and failure of various components of this program as a function of the various types of disabled participants.

The approach was to operate the program in a traditional academic manner with lecture, laboratory, and field experience across three major topics: Scientific Communication and Methods, Marine Biology, and Oceanography. For the academic portion of the program, the 23 participants were in the field about 45% of the time, in laboratory about 30% of the time, and in lecture about 25% of the time. Each student also had a

(1) The difference in these estimates reflects the range of estimates of handicapped individuals in the general population.

special mini-research project that he or she completed over-and-above the regular presentations.

It is the intent of this paper to examine the findings, including general impressions, of the project in regard to its various academic and non-academic aspects, as they relate to the various types of handicapping conditions.

DESCRIPTION OF THE PROGRAM

The "traditional" program was taught using lectures, visual aids, laboratories, and field experiences, with certain modifications such as the use of braille materials and tactile models as well as by the use of signers and reverse-interpretators.

The content of the program was divided into sub-topics under the respective major disciplines viz., the sub-topics and experiences for the first major topic (Scientific Communications and Methods) dealt with: descriptions of the general coastal area near Wallops Island, Va.; introduction to science and the marine sciences; science vs. textbook writing; descriptive scientific methods; hypotheses and their testing; design of experiments; types of information; means, standard deviations, and ranges; observational/descriptive exercises; barrier island transect evaluations; and the transect sampling and analysis.

Sub-topics for the second major topic (Marine biology) included: zones of the ocean; zones of the bay; methods of collecting, identifying, and preserving marine specimens; sampling the various zones for plants and animals; energy transfer; trophic levels; animal behavior; habitat specification; coastal bird studies; Donax clam migration; marine physiology; and estuarine dynamics.

Sub-topics for the third major topic (Oceanography) were: general aspects of oceanography; components of the ocean and coastal waters; equipment used in oceanographic studies; introduction to meterology; a visit to the NOAA meteorological station; navigation; waves and currents; tides and variation in tidal heights; water quality and its assessment; the evolution of barrier islands; and the formation of beaches.

Along with the academic portion of the program (given above) the participants were exposed to a variety of non-academic experiences including: beach combing, sea shell handicrafts, picnics, canoeing, wildlife films, swimming, tour of NASA facilities, visits to museums and a lighthouse, clamming, fireworks, and hikes.

Three other intergal activities were also performed: a seminar on the progress of their mini-research projects, a final formal research seminar presentation, and writing "laboratories" were held (mainly dealing with how to write a scientific paper).

The mini-research project was performed over the latter portion of the program. The projects were short and were usually completed in several days, but they were scattered across the last half of the program. The seminars were based on the topics of the participants projects. The topics of the completed mini-research projects are listed below:

1) Comparison of Sand Grain Sizes Between the Beaches of Assateague (open ocean) and North Wallops (protected by sand bars).
2) Sand Grain Size and the Occurrence of Donax Clams.
3) Preparation (including brailling) of Herbarium Specimens of the Plants from the Dune Areas of North Wallops Island.
4) Respiration Rates of Male and Female Fiddler Crabs at Two Different Temperatures.

5) Substrate Preference of Blue Crabs.

6) The Number of Trees with and without Galls on Small and Large Scarlet Oak Trees on the Marine Science Consortium Campus.

7) The Importance of Vision and Smell in Killifish Feeding.

8) Environmental Preferences of Male Blue Crabs.

9) Temperature Tolerance of Killifish.

10) Food Preference of Blue Crabs.

11) The occurrence of Melampus Snails in Low Marshes.

12) Periodicity of Clam Respiration.

13) Comparison of Salinity and Temperature at Low and High Tide at Four Different Locations.

14) Temperature Tolerance Ranges for Large and Small Mole Crabs.

15) The Effects of Tides on Salinity.

16) Environmental Remote Sensing.

17) The Activity and Respiration Rates of Killifish in Different Types of Water.

18) Root Depth of Sea Rocket Plants in Relation to their Distance from the Ocean.

19) Colred Light Preference of Fiddler Crabs.

20) The Density of Bayberry Bushes in Three Zones on North Wallops Island.

21) Feeding Time Preference of the Blue Crab.

22) Light and Cover Preverence of the Blue Crab.

23) The Effects of Temperature and Relative Humidity of Plant Density.

PROBLEMS OF THE PROGRAM

Aside from the usual problems of operating a summer SST program, several unique problems were noted. The major problems were not concerned with the academic aspects of the program, but dealt with the free-time portion of the program. Because of the severity of handicaps in many cases (total blindness, total deafness, or wheel-chair bound) the staff felt that there was an extra degree of concern and attentiveness necessary for the participants. For example, the counselors were not all signers and when dealing with the deaf participants this caused considerable difficulties, especially in the field activities and in the after-hours activities. Excessive dormitory noise, by the deaf participants, caused problems for the other participants in terms of studying and sleeping. Free time programming of recreational activities that were utilizable by all participants were quite difficult to design and/or operate.

Another major non-academic problem of the program dealt with the lack of air conditioning for the lecture and laboratory aspects of the program. This is not usually a unique problem, however it can be for certain types of handicaps (asthmatic, some orthopedic, etc.). Likewise, sleeping problems in the non-cooled dormitories lead to certain difficulties (noise plus discomfort were more of a problem for some specific handicaps as compared to others).

The difficulties in the academic portion of the project primarily centered around the communication difficulties between the deaf and hearing participants and the instructors. Although, there were two excellent interpreters and reverse-signers present (both science teachers) throughout the program, the dialetic differences in signing, coupled with the generally poor level of reading skill among the totally deaf participants greatly hampered the articulation levels from the instructor and textual material of the totally deaf students. The pace of the program was slowed somewhat by these communication problems and certain of the other (non-totally deaf) participants became annoyed. The research projects helped somewhat in remedying this problem since the after-lecture, after-laboratory briefings (in a reinforcement session by the interpreters) were only attended by those individuals needing further explanations. The other participants were free to work on their project, if they so desired, during this reinforcement session. The blind taped the lectures and used the tapes as reinforcers to the lecture material. Another problem, specified by the blind participants concerned the lack of specific braille materials, but from the academic evaluations (presented in the next session) this deficiency did not appear to significantly hamper the totally blind students.

EVALUATIONS IN THE PROGRAM

Three participant evaluations were performed: 1) the description/characterization of the participants, 2) their personality profiles, and 3) their academic performance.

PHYSICAL AND ACHIEVEMENT CHARACTERIZATION OF THE PARTICIPANTS

The program included three general groups of handicapped participants: blind, deaf, and orthopedic. While an ardent effort was made to recruit an equal number of each type of handicap (and sex), the end result was not an equal distribution either for the type of handicap nor for sex. The differences in the sex proportions could have been due to the interest levels in Marine Science with proportionality more males interested in Marine Science in the general population. There were fifteen students with hearing disabilities, five students with visual handicaps and three with orthopedic handicaps. Also, one of the twenty-three students had a dual handicap, being both totally blind and orthopedically handicapped (he was classified above as blind). Of the 33 respondents to the recruiting information there were only two minority students. Both of these students were extended offers to the program but it was not until the students arrived at the Marine Science campus that it was realized that the one black student decided not to attend. The remaining minority student, a deaf American Indian, accepted and participated in the program.

The science backgrounds of the students were generally quite similar having, on the average, two previous science courses. These included biology, general science, ~~physical science~~, earth science, or chemistry. The average science grade for the students was slightly better than a "B" grade.

The types of schools and academic backgrounds that were represented were extremely varied and, consequently, the indicators of general academic ability were not as complete as might be desired. Of the nine students for whom I.Q. scores were available, the mean was 116.6. Other scores were also included with the most common, and useable, being the PSAT scores. Of the six students submitting PSAT scores, the averages were 46.3 for verbal and 46.7 for math.

PERSONALITY EVALUATION OF THE PARTICIPANTS

Personality evaluations of the participants were done by the staff who evaluated the students on the basis of twenty personality attributes. These attributes were then grouped into three macro-categories, all of which were found to be scored above the median (i.e., favorable) on the scale used. The most positive grouping of students contained the attributes: friendly, respectful, pleasant, patient, and cooperative. The second (mid-grouping) having intermediate scores consisted of the attributes: courteous, participatory, adaptive, responsible, interested, helpful, persistent, resourceful, and industrious. The third and most negative grouping of students included the attributes: self-motivated, self-disciplined, considerate, mature, aggressive, and competitive. Although the data were not evaluated in a formal manner, the three macro-groupings given above generally corresponded to the orthopedic, blind, and deaf; respectively.

ACADEMIC PERFORMANCE EVALUATIONS OF THE PARTICIPANTS

Ten separate tests were used (each evaluating a specific academic aspect of the program) in examining the various experiences of the academic portion of the program in order to determine an average student academic performance level. The tests were presented in both written and oral form. The tests were not signed although some questions were explained by signing. After the individual evaluations, the participants were divided into five categories, according to handicap and to their degree of handicap. The categories are presented in Table 1, along with the overall average performance of the group. The lowest values represent the highest (or best) scores.

Table 1. Student Academic Performance by Type and Degree of Handicap.

Handicap (degree of)	Ranking	N	Average Relative Score (1)
Blind (partially)	highest	2	11.5
Hearing Impaired (partially)	next highest	4	13.0
Blind (total) (2)	third highest	3	13.7
Orthopedic	next to lowest	3	17.3
Deaf (total) (3)	lowest	11	18.0

(1) The lowest score is best.
(2) The tests were usually brailled and the responses brailled.
(3) This group had an enormous difficulty in reading and writing in the test environment (as well as in the program in general).

From Table 1, it is clear that the two partially blind students had the best average performance. These students with partial hearing were second in performance, followed by the totally blind, the orthopedic, and the

profoundly or totally deaf; respectively. Although the totally, or profoundly deaf, participants had the lowest average scores, it is not clear whether, or not, the testing procedures was biased (against the profound or totally deaf), especially due to the fact that this group had the greatest degree of communication difficulty.

EVALUATIONS BY THE PARTICIPANTS

At the beginning, and again at the end, of the program, a series of eight questions pertaining to Marine Science were asked of the students, in questionnaire form, on a 5 point ranking scale.

The eight questions were concerned with whether Marine Science was: fun, practical, of great value, and did they like Marine Science, did they like field work, should everyone study Marine Science, do they like laboratory work, and could Marine Science be of help to the student. The average score for all questions, for both the pre- and post-evaluation were above the median. However, there were three clusters of responses in regard to changes in the attitudes of the participants between the pre- and post-evaluations. The most positive changes observed occurred for the three questions as to whether Marine Science was: 1) practical; 2) was fun; or 3) was of great value. A mid-group of three questions concerned with: 1) whether the students liked Marine Science; 2) liked field work; and 3) whether everyone should study Marine Science, were also positively changed between the pre- and post-evaluation, but not to as great an extent as the first grouping. The final group consisted of two questions which had no appreciable change. These questions were concerned with whether Marine Science could be of help to the student and if the students liked laboratory work. Hence, the attitudes of all of the questions about Marine Science appeared to be positively changed except for the questions concerning the fact that Marine Science would be of great help.

EVALUATION OF LEARNING ENVIRONMENTS BY THE PARTICIPANTS

Each academic section was evaluated by the students in the form of an anonymous questionnaire at the end of the topic section (or the day). These were divided into four classifications: enjoyment, difficulty, the amount learned, and clarity. The responses were scored on a scale ranging from 1 to 5. The results of the analysis divided into the three major functional groupings of laboratory, lecture, and field sections.

Using a "fun-boring" classification, the responses indicated that the field experiences were the most fun with the laboratory rating next and the lectures the least fun. In the difficulty evaluation there was no difference between the lecture and field experiences, but at the "easy" end of the scale, the laboratories were scored as being the easiest. It was the general concensus of the participants that the degree of learning was about equal from all three sections. The clarity aspect indicated that the field sections were the most clear, the laboratories of intermediate clarity, and lectures the least clear.

SUGGESTIONS BY THE PARTICIPANTS FOR IMPROVING THE PROGRAM

The open-ended portion of the student's evaluations is summarized below. The most general comment concerned a desire to have the handicapped and regular (non-handicapped participants) NSF pre-college programs together as one integrated course. Also, several students wanted to have SCUBA diving included as part of the program. While a few students felt that they should have more freedom after classroom hours, there were many others who stated that there should be more strict discipline and more strictly enforced quiet hours. This apparent contradiction seems to have come about between the non-hearing (wanting more freedom) and the hearing students (wanting more programmed activities). Other comments dealt with organization and scheduling. Since this program was the first of its kind, there were numerous schedule changes and, hence, an appearance of a lack of organization to some students. It was necessary to alter plans due to oversights concerning the handicap problems, weather, tides, and the coordination of equipment, vehicles, and vessels with the other MSC programs. The need for effective cooling of the lab and dormitory rooms was another change strongly recommended by all participants.

A few individuals expressed some difficulty with certain of the academic materials such as the scientific method, energy transfer in ecosystems, and in developing their ideas for the short research investigations. Other participants felt that the academic materials should be covered in more depth and should even be accelerated. These types of conflicting recommendations are, perhaps, the most difficult to deal with because some of the students are slower to grasp materials than others, not only because of communication difficulties (due to their various handicaps) but also due to their variety of backgrounds. Some were "mainstreamed" in regular high schools while others were in schools for their unique handicap, although this seemed to make a difference, it was not formally evaluated.

There were a few specific comments that apply to certain of the handicaps. One deaf student felt that the signing during lectures was too fast (hence also the lecturer's presentation). In the opinion of the two signers/reverse interpretors on staff, this student, however, did not appear

In the course of the program evaluations, it was felt that it would be useful to construct a rudimentary life function facilitation matrix by the major category of handicap which would assist in future planning activities. In Table 2 is given the initial assessment of needs in a pre-college Marine Science Course, according to type of handicap. These needs are those over and above the usual needs of the "normal" or non-handicapped student. Many of these needs would also be required for any field oriented program and are not unique to Marine Science programs.

As experience is gained in these integrated handicapped programs the list of special needs will be expanded. The problems could be ameliorated somewhat with peer interaction. One of the bright spots of the program was the peer interactions aspects in which there was peer concern and assistance throughout all phases of the program.

LITERATURE CITED

E.C. Keller, III, R.D. Allen, B. Allamong, J. Allamong, and E.C. Keller, Jr., 1977. Experience in Pre-College Training in Biology at West Virginia University. Proc. W. Va. Acad. Sci. 47:229-234.

E.C. Keller, Jr. and Helen E. Keller. 1977. Proportion of Outstanding Pre-College Handicapped In Student Science Programs in 1975. AAAS Abstract, AAAS Annual Meeting, Denver, Colorado.

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Table 2. Examples of Resource and Personnel Needs for Teaching, Living Environment Equalization, and Field Experiences for Various Handicaps in Four Educational/Social Environments. These Needs Are in Addition to Those Common Needs in Training Pre-College Students in Marine Science.

Environmental Situation	TYPE OF HANDICAP			
	Blind	Deaf	Orthopedic	Multiple Handicap
Laboratory	"talking" calculator tactile models, braille materials, recorders tactile graphics assistants for tactile graphics, assistance for neutralization of dangerous situations,(1) and help with equipment	signer, reverse-interpreter captional films, increased use of visuals	help with equipment special tables (heights & designs), wheelchair assistance	combinations of needs according to handicaps
Lecture	braille materials, recorders, tactile graphics, assistance for tactile graphics	signer, reverse-interpreter, increased visuals, captional films and visuals	recorder or note taker	combinations of needs according to handicaps
Field	recorder, assistance in description and tactile aspects	signer, reverse-interpreter	wheelchair assistance, tie down in boats & vehicles, special transportation needs	combinations of needs according to handicaps
Readings and Visuals	reader, or Optocon, braille materials, large type	captioned visuals. supplement readings with signed briefing sessions	none for moderately handicapped	combinations of needs according to handicaps
Non-Academic	[illegible]istance in meals, ass[illegible] in travel, as[illegible] in laundry, ass[illegible] in organization [illegible]sonal and academ[illegible]	signer and reverse-interpreter for travel, amplified telephones	assistance for meals, assistance in travel, assistance in laundry, assistance in bathing	combinations of needs according to handicaps

(1) For example, k[illegible] [illegible]etpants away from dangerous fish or animal parts (e.g., shark teeth, crab claws, sea urch[illegible] [illegible] [illegible]ing ray tails, etc.).

THE ROLE OF THE SCIENCE MUSEUM IN SCIENCE EDUCATION OF THE HANDICAPPED

by Dennis Schatz
and Holly Overman

Science museums offer a unique resource in the science education of handicapped students that is often overlooked both by the school educator and by the museum staff. This article is addressed to both of these audiences to encourage the greater use of science museums in the total process of science education for handicapped students.

Science museums are natural locations for resource centers that provide inservice workshops concerning the teaching of science to handicapped students and for depositories for loan of adapted science activities, aids and appliances. The often unique collections, equipment, and facilities of museums can also offer science experiences at all levels unavailable in any local school district. The need for these resources has become especially acute with the implementation of PL94-142. This has placed a demand on the regular classroom and special education teacher to become knowledgeable about aids, activities, curriculum and teaching techniques appropriate for children with different handicaps.

There are three primary ways that science museums can serve the needs of handicapped students:

1. Become local resource centers for demonstrating and/or disseminating adapted aids, appliances and curriculum materials; recommend resource individuals who are interested in working with handicapped students, or have appropriate science materials for use by handicapped students.

2. Provide in-service workshops for both regular classroom teachers and special education teachers concerning techniques and materials for teaching handicapped students, especially in a mainstream situation.

3. Offer museum programs which are appropriate for handicapped students, and actively encourage participation by them.

AS A RESOURCE CENTER

There are a number of sources for adapted equipment, such as the American Foundation for the Blind, the American Printing House for the Blind, and the individual state's clearing houses for materials purchased from the American Printing House. There are several curriculum development projects which focus on materials appropriate for various types of handicapped students (Science Activities for the Visually Impaired, Adapting Science Materials for the Blind, Science and Art for Special Children, Me and My Environment). In addition, a number of individuals have reported personal adaptations and equipment or curriculum (Tombaugh, Kaufman, Baughman and Zollman). Although there are national resource centers which keep lists of adapted materials and information on curriculum (such as the NCEMMH in Ohio), there are usually few, if any, local resource centers for teachers where they may find out about the existence of the material and also get information on how to utilize these materials in their programs. Science museums can play the vital link in connecting the existing materials and activities to the teacher in the classroom.

It is costly for each school district to provide the in-service workshops and dissemination of information concerning science materials for the handicapped since there are relatively few handicapped students per district. Science museums already function as a science resource for the community on many aspects of science education, and they often serve a large region of a state, or an entire state. Thus they are an ideal, cost effective location for housing resource centers concerning science education for handicapped students. Depending upon the local and state distribution system for items such as close-circuit video systems for the partically sighted, the science museum may want to have these resources also available, or at least available for use during in-service workshop.

As a resource center for students, parents, and other science educators, the science museum should make available for loan science activities adapted for handicapped students. This should certainly include all commercial curricula materials available (Me and My Environment, Science Activities for the Visually Impaired, etc.) and should be augmented as the need arises with other materials, either designed by the science museum staff or located through the national resource center (NCEMMH), or the museums own list of appropriate materials.

A full set of basic aids and appliances should also be available for loan, including such items as brailled thermometers and microfiche or large print copies of activities for visually impaired students.

The science museum should also supply:

1. a resource file of people of interested in working with special education teachers and students;
2. a bibliography of articles on science education for the handicapped;
3. general consultation services;
4. staff training for other science education centers, such as environmental education centers, other museums, scout leaders, etc.

Item 4 is an important area that is too often neglected. Many handicapped youth spend much time in community and/or recreational programs, including summer camps, and after school programs. The introduction of science activities in these informal learning situations can often be the most rewarding and interesting.

IN-SERVICE WORKSHOPS

Housing of a resource center in the science museum leads logically to the single most important service that science museums can offer, in-service workshops concerning the teaching of science of the handicapped students. Some workshops may be offered through local college and universities for those teachers interested in obtaining credit. Individual districts may wish to contract with the science museums to offer in-service programs for their teachers. These workshops may vary from single afternoon, 3-hour workshop to a more extensive multiple session workshop. Many science museums are already familiar with this type of in-service program in the areas of elementary science and mathematics, or specialty areas such as archeology or astronomy.

If external funding can be found, the science museum may want to arrange a more comprehensive in-service mechanism for the entire area they serve. An effective technique for doing this is to arrange a three to five week summer workshop that trains leadership individuals to give similar workshops throughout the local area or state. These individuals would meet daily during t to 5 week period to obtain information on materials available and techniques for using these materials. They would also learn strategies to give similar workshops.

During the following school year, these individuals would offer workshops on the school distict level to regular classroom and special education teachers concerning the materials they studied during the past summer. They also continue to act as local resource people throughout the year for the teachers in their workshops. The development of such in-service programs, no matter how extensive, would complement nicely, and make known the resources available through the science museum.

MUSEUM PROGRAMMING

Many science centers have collected materials and equipment which allow them to offer unique science experiences for the students. The Oregon Museum of Science and Industries has science research programs for highly motivated high school students that allow them to do experiments and use equipment not available in the schools. Many science museums have archeological or biological artifacts, or have expensive equipment, such as an electron microscope or planetarium, that are not available in the schools. Many scientists look back to their involvement in science museum special programs as a key motivator in their career in science. Science museums need to make such programs accessable to handicapped students, and this can be easily accomplished using the aids, appliances and skills developed as part of the science education for the handicapped resource center.

In addition to making more specialized museum programs available to the handicapped, it is important that the science museum analyze its programs at all levels to encourage greater use by the handicapped. Science museums need to modify old exhibits and develop new exhibits which give multi-sensory inputs. Programs at the elementary school level should especially be made inviting to handicapped students, for it is during that time that the students are exploring and molding their future interests. An elementary level student fascinated by a science program is a good candidate for the special high school class. In many cases it will not only be necessary to adapt and modify the program, but it will be essential to actively encourage participation by handicapped students. At the present time, handicapped students do not consider science museums as natural places for becoming involved. Therefore, an effective advertising of programs available will be necessary to get their participation.

Finally the Science Center becomes a logical place to develop science career information, especially since science museums continually work with scientists in the community in the development of all their programs.

IMPLICATIONS FOR SCIENCE CENTER STAFFING AND FUNDING

Implementation of the programs outlined above not only require the committment of the science museum staff, but hiring of new staff or a change of assignment in the present staff. It will also require the allocation of funding to cover the cost of the program. If new staff is hired, this would be a very appropriate time to implement an affirmative action program to hire handicapped individuals.

Funding of the program outlined above is substantial for at least the first 1 to 3 years as materials and equipment are required, museum programs are adapted or developed and extensive workshops started. We are presently pursuing funds from the Washington State Superintendent of Public Instruction to implement such a program similar to that above. We recommend science museums pursue similar funding in their state. After the initial few years, we believe that the cost of continuing such a program can be incorporated into many science museum's general budgets, possibly augmented by fee for service arrangements with local school districts and/or state agencies.

An essential component of any program for the handicapped is the continuous imput from individuals in the community who are handicapped and/or work with handicapped students. An advisory group including regular classroom and special education teachers, handicapped adults and students, and local scientists can help in giving appropriate direction to the museum's program. Equally important, these individuals can help in informing the community about the program's existence.

Science museums are now in the position to offer a unique service to the education community. Neither museum staff or school educators should pass up the opportunity.

AN INTEGRATIVE MODEL FOR PREPARING REGULAR CLASSROOM TEACHERS TO WORK WITH HANDICAPPED STUDENTS IN SCIENCE

DONALD W. McCURDY

After a long and complicated legislative and judicial history, the Education for all Handicapped Children Act became Public Law 94-142 when President Ford signed the measure on Nov. 29, 1975. This milestone legislation provides for a permanent federal obligation to help school districts raise the quality of education for the nation's eight million handicapped children to a new standard of excellence and opportunity.

Recent court decisions and new laws in many states have determined that handicapped children have the same educational rights as other children - that they are entitled to education according to their needs. It has also been determined that these needs should be met at public expense - either in special or regular classes or some combination of the two. School programs and facilities must be modified accordingly.

It is obvious that Colleges of Education must also make necessary modifications in their program to prepare regular classroom teachers who are competent to work with handicapped children. The classroom teacher can no longer assume that handicapped youngsters will be carted off to special schools or special education classrooms. Under the principle of "least restrictive" environment, marginally handicapped children will be the responsibility of the "regular" classroom teacher. The special education teacher will become a "resource person" who will help the regular teacher with diagnosis, prescription, and the identification of specialized instructional materials.

Institutions of higher education have responded in various ways to the challenge of preparing teachers for working with handicapped youngsters. Some states (e.g., Missouri) have mandated courses to prepare teachers for mainstreaming.

At the University of Nebraska - Lincoln, it became apparent that establishment of a specific course relating to the education of the handicapped in the regular classroom was inappropriate on several dimensions. The most critical of these was that a separate course would be philosophically inconsistent with the concept of regular education participation in the education of the handicapped; this would tend to perpetuate a segregation of regular education and special education functions. In light of this consideration, an approach which would integrate instruction and practicum experiences with handicapped students into the existing program was seen as the best alternative. We have chosen to integrate mainstreaming concepts, principles, and experiences throughout the professional sequence. For example, in the freshman level "Introduction to Education" course, such topics as the historical, legal, and legislative elements of the education of handicapped young people are elaborated and discussed. The sophomore level course in developmental psychology deals with selected physical disorders and their psychological ramifications. This integration is manifested most completely in the junior and senior level field based components of the secondary level teacher education program which will be described in the next section of this paper.

Competency Based Teacher Education - A Vehicle for Preparing Teachers for Mainstreaming

For the past eight years, the University of Nebraska - Lincoln has been involved in the development of a performance/competency based teacher education program. This program has been identified by the acronym NUSTEP (Nebraska University Secondary Teacher Education Project). NUSTEP is an attempt to build an integrated and articulated professional education program based on a set of competencies to which the college is committed. It consists of a nine semester hour block of courses which are fused together into a sequence of generic and specialized subject area modules. The content for this block is special methods, learning theory and principles, and a pre-student teaching practicum experience. Students spend approximately half of the semester on campus in small discussion groups, large group lectures, and individualized learning activities. Microteaching with peers is used as a vehicle for practicing and demonstrating selected skills. The other half of the semester is spent in a public school where the student functions as a teaching assistant. The assistant's responsibilities begin with limited one-to-one tutoring experiences and such duties as helping to set up laboratory activities. Duties gradually expand until by the end of the semester the individual may be responsible for whole class instruction for several days at a time.

Many students are assigned to work in teams of three or four with a single cooperating teacher. Leadership roles may be rotated among the team members so that by the end of the semester the individual will have been responsible for planning a week of instruction and providing the team leadership for that week.

Since most of the classes in which the NUSTEP students are assigned are general education courses, many of them contain mainstreamed students with various kinds of handicaps. This provides excellent opportunities for developing the specialized skills needed for working with atypical students.

The NUSTEP program is based on a set of basic generic competencies to which the staff is committed. These competency statements are organized about the six basic roles of a teacher:

I. The Teacher as Instructional Planner

II. The Teacher as a Director of Learning Experiences

III. The Teacher as Assessor and Evaluator

IV. The Teacher as Humanizing Agent

V. The Teacher as Professional Educator

VI. The Teacher as a Subject Area Leader

Examples of competencies under role #1 above (The Teacher as Instructional Planner) are:

1. The teacher identifies and diagnoses learner needs.

2. The teacher specifies desired learner outcomes (objectives) to meet diagnosed needs.

3. The teacher determines assessment criteria for each outcome.

4. The teacher plans learning activities to achieve desired outcomes (objectives).

For the past three years, the University of Nebraska - Lincoln has operated a project funded by the Bureau of the Handicapped entitled "Educating the Handicapped in the Regular Classroom." One of the outcomes for this project is a set of competencies for regular classroom teachers in regard to their work with handicapped students. These competencies are presently in the process of being incorporated into the NUSTEP project and other segments of the teacher education program. Some of these competencies are listed below:

1. Recognize the developmental sequence in the tool subject areas of language, reading, mathematics, science, etc.

2. Demonstrate the knowledge of basic etiology of exceptional children.

3. Be able to identify or diagnose learning problems and other handicapping conditions.

4. In planning for individualized instruction the classroom teacher will use all the available support personnel within the school setting; resource teacher, educational strategist, special education teacher, speech and hearing personnel.

5. Will be able to identify the human resources available and match resource personnel to student need.

6. Recognize and identify sources for educational media materials for handicapped children.

7. Identify and explain functions of community resource agencies.

8. Know the background of legislation concerning the handicapped child in the regular classroom.

9. Recognize and be able to relate the current legislation and know the role it plays within the classroom.

Competency Development Through Modules

The NUSTEP project is divided into two major segments - the generic portion which deals with competencies needed by all teachers regardless of discipline and the subject area portion which pertains to the skills and knowledge peculiar to the discipline. Examples of the generic modules are:

I. Teaching Methods for the Classroom

II. Task Analysis & Behavioral Objectives

III. Assessing Student Performance

IV. Cueing: Nonverbal, Questioning, Set & Closure

V. Classroom Management: Reinforcement Principles, Contingency Contracting

VI. Individual Differences

A copy of module VI, Individual Differences, may be found in the appendix of this paper.

The science education component consists of a series of fifteen modules. Some of the titles of these modules are:

1. Inquiry Teaching Strategies

2. Selecting Content and Materials in Science

3. Curriculum Development in Science

4. Long Range Planning in Science

5. Laboratory Instruction

The modules listed above are presented in a variety of formats including lectures, discussions, self instructional mediated materials, and individual contracting. Microteaching experiences are provided as a means for students to practice and/or demonstrate particular skills. Often these sessions are videotaped for subsequent analysis by the student and/or his or her supervisor.

Each module consists of the following parts:

1. Student Guide - a set of instructions on how to complete the module.

2. A problem statement - an orientation to the purpose of the module.

3. A module overview.

4. Behavioral objectives.

5. An "On Campus Work Sample" - a written or oral sample of the students' work pertaining to a simulated teaching situation.

6. An "Off Campus Work Sample" - a written or oral sample of the students' work pertaining to a real teaching situation in a public school.

7. Check lists for the work samples - these check lists enable the student to insure that he/she has provided for all the essential components.

8. Skill Acquistion Section - this section identifies various printed and mediated materials which deal with the various objectives of the module and are available in the Media Center or University Library.

A copy of the Individual Differences Module is provided in the appendix of this paper as an example of how the NUSTEP modules are adapted to insure attention to the needs of handicapped children. For example, three objectives from this module are as follows:

> "The student will be able to identify at least one change in classroom arrangement that would facilitate mainstreaming of handicapped individuals."
>
> "The student will be able to describe two potential modifications of materials and/or format that would facilitate mainstreaming for individuals with handicaps."
>
> "The student will be able to describe at least two ways in which objectives and assessment procedures could be modified to facilitate mainstreaming of handicapped individuals."

An example of an off campus work sample is as follows:

"For the off campus work sample you will:

1. Read the case of Mary (Mary is a fictitious physically handicapped youngster who is confined to a wheelchair.)
2. Analyze the classroom environment of your teacher assisting setting relative to meeting Mary's needs.
3. Analyze your teaching style, or the one(s) to be used in teaching your unit, relative to Mary's needs.
4. In your off campus setting, identify who would be involved in a staffing/referral process for the case of Mary, and briefly describe their roles.

NOTE In completing this work sample, assume that Mary is a handicapped student who is to be mainstreamed in "your" classroom (one similar to your teacher assisting setting) while you are teaching your unit plan."

All of the generic and many of the subject area modules contain references to various handicapping conditions. Students are required to respond in terms of how they would handle various problems and opportunities created by having handicapped children in the classroom.

In the science modules students are asked to indicate how they would adapt various laboratory activities for students who are orthopedically handicapped or students who are blind or visually impaired. Students are also required to consider how the selection of content and materials might be influenced by the presence of various types of handicapped children. The choice of curriculum materials is another place where students must consider the special needs of handicapped children.

There is very little current professional literature in this field. Recent articles by Weems[1] and Baughman and Zollman[2] which describe physical science laboratory courses for the physically impaired and blind respectively are rare examples of work in this field. More work has apparently been done at the elementary level than in the secondary schools. The March 1975 issue of Science and Children was devoted entirely to science for the handicapped.

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[1]Bruce Weems, "A Physical Science Course for the Visually Impaired", The Physics Teacher, Sept. 1977, pp. 333-338.

[2]James Baughman, Jr. and Dean Zollman, "Physics Labs for the Blind", The Physics Teacher, Sept. 1977, pp. 339-342.

Much research and development work remains to be accomplished in the area of science for the handicapped. It is a fertile field that must be cultivated in the near future if science teachers and science educators are to respond adequately to spirit as well as to the requirements of Public Law 94-142. Legislation alone, without the enthusiastic support and commitment of the teaching profession, will not get the job done.

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MODULE VI
Individual Differences

Credits

Dr. Don McCurdy	Nustep Project Director, Department of Secondary Education
Dr. Royce Ronning	Teaching Council Grant Administrator Project Coordinator, Department of Educational Psychology and Measurements
Dr. Roger Bruning	Consultant, Department of Educational Psychology and Measurements
Spencer Ward	Editing and Module Development
Chris Petersen	Audio-Visuals and Module Development
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This project was made possible by a Teaching Council Grant, UN-L

Materials Revision and Production 1977

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Student Guide

1. Read the Problem Statement and the module Overview. Try to predict the sorts of behaviors you will be learning in this module.

2. Read the ON CAMPUS and OFF CAMPUS WORK SAMPLES which describe your tasks for the module.

3. Pay particular attention to the WORK SAMPLE CHECKLIST which forms the basis for evaluation of your work in this module.

4. Decide whether or not you can complete the ON CAMPUS WORK SAMPLE. If you feel that you must first acquire more information and skills complete the tasks in the SKILL ACQUISITION SECTION choosing carefully those items you think can help you.

5. A. Complete the ON CAMPUS work sample using the Work Sample Checklis as an outline.
   B. Fill out the Work Sample Checklist and then attach the checklist to the ON CAMPUS work sample.

6. A. After meeting all the criteria in the ON CAMPUS work sample, complete the OFF CAMPUS work sample in your TA setting.
   B. Fill out the Work Sample Checklist and attach the checklist to the OFF CAMPUS work sample.

7. You will receive credit for this module upon meeting all of the criteria for all of the OFF CAMPUS work sample.

Problem Statement

Remember when you entered a new class not knowing any of the other students, and feeling uneasy about how you whould behave? Remember the blur of faces, so indistinguishable at first, and yet so different after you became a member of the group? As you got to know them, the differences among members of the class resulted in your making decisions, decisions such as with whom to eat lunch, with whom to study, with whom to double-date. Sometimes those early decisions were good ones, sometimes not.

Each time a teacher meets a new class the same experience occurs. The teacher sees a blur of faces, but after only a few class meetings certain differences among individuals begin to stand out. Because student groupings do tend to be heterogeneous, it is essential that teachers be able to make appropriate instructional decisions for a wide range of student needs. As a result of "mainstreaming"--which provides that mildly handicapped students be educated in the least restrictive environment that meets their needs--the least restrictive environment for most mildly handicapped students will be the regular class. Thus, the regular class teacher may have an even wider range of student differences to contend with. The purpose of this module is to help you deal rationally with questions as:

"What sorts of differences among students <u>should</u> lead to alternatives in how I teach?"

"When I am faced with a wide range of student differences, particularly in the case of having a mildly handicapped student in the class, how do I adapt to them?"

"Can I behave in such a way that <u>each</u> student will learn to his potential?"

Clearly, books could (and have been) written about individual differences among us humans. Since we are not writing a book, this module will focus on individual differences along two related dimensions:

A. The heterogeneous nature of classrooms as a whole, and . . .
B. The unique needs of mainstreamed mildly handicapped students.

Module Overview

The goal of this module is to make sure that on completion of the NUSTEP program you will be able to design a set of instructional experiences which will enable you to give maximum opportunity for learning to every student in the class. In the course of completing this module, you will investigate the nature of student differences (both "normal" and handicapped) and how those differences may affect your decisions about how a class should be taught. Particular emphasis has been placed on teacher skills in adapting instruction for the mildly handicapped student who has been placed in the regular classroom, i.e., "mainstreamed".

<u>NOTE</u>

The tasks in this module will help prepare you to demonstrate the following competencies (key competencies are indicated by an *):

1.1*
2.1*
2.2
2.3
3.1
3.2
3.3
4.1
4.2
4.3*
4.4*
4.5*
6.2

for your information

In the previous five modules you have learned the component skills essential in individuali[illegible] instruction. In the course of this module you will be studying the pr[illegible]s of individualization in the broad context of the heterogeneous classroom and more specifically, in the context of the handicapped student who is mainstreamed. In the ON CAMPUS WORK SAMPLE you will have an opportunity to analyze yourself as a learner and as a professional in the role of teacher. In the OFF CAMPUS WORK SAMPLE you will have an opportunity to analyze a case study of a handicapped student who could be mainstreamed in your classroom.

<u>BEHAVIORAL OBJECTIVES FOR MODULE VI</u>

The Student Will Be Able To (SWBAT) describe his/her preferred mode of instructional input.

SWBAT describe his/her preferred mode of instructional output.

SWBAT identify at least two individual characteristics which influence his/her learning style.

SWBAT describe at least two ways in which the NUSTEP program:
1. facilitates learning in their preferred style.
2. inhibits learning in their preferred style.

SWBAT describe at least two ways in which the NUSTEP program;
1. individualizes instruction to meet the heterogeneous needs of students.
2. could be modified in order to facilitate learning by all students.

SWBAT identify at least one change in classroom arrangement that would facilitate mainstreaming of handicapped individuals.

SWBAT describe two potential modifications of materials and/or format that would facilite mainstreaming for individuals with handicaps.

SWBAT describe at least two ways in which teaching style could be modified to meet the needs of an individual learner.

SWBAT describe at least two ways in which objectives and assessment procedures could be modified to facilitate mainstreaming of handicapped individuals.

SWBAT describe at least two ways of evaluating the progress of a mainstreamed student.

SWBAT identify at least one responsibility of the regular classroom in:
1. the referral process.
2. the staffing process.
3. the implementation of the IEP.

SWBAT identify those persons who would be involved in the referral and staffing process in an off campus setting <u>and</u> be able to identify at least one responsibility for each person/role identified.

A. On Campus Work Sample

FOR THE ON CAMPUS WORK SAMPLE YOU WILL:

1. ANALYZE YOUR OWN UNIQUE LEARNER STYLE.
2. ANALYZE THE EFFECTIVENESS OF THE NUSTEP PROGRAM in meeting your needs as learner.
3. ANALYZE THE EFFECTIVENESS OF THE NUSTEP PROGRAM in meeting the needs of at least two handicapped students.
4. After viewing the NETCHE Tapes on "mainstreaming," ANALYZE YOUR FUTURE ROLE AS A TEACHER who is a participant in the staffing process.

NOTE

1. It is essential that you view all three NETCHE tapes on mainstreaming before attempting to complete this work sample.
2. It is suggested that this work sample be completed in conjunction with any "self-analysis" project you complete in your discipline area (Spiral II).

Checklist
MODULE VI
ON CAMPUS WORK SAMPLE

Student My work sample contains the following:		Supervisor The work sample turned into me contains the following:
	I. LEARNER STYLE:	
______	A. Describe your perferred source/means of instructional "input" ("how you learn best"--i.e., reading, media, etc.).	______
______	B. Describe your perferred source/means of instructional "output" ("how you report best"--i.e., written, oral, etc.).	______
______	C. Describe at least two other individual characteristics wihch influence your learning style (i.e., cultural background, married and have a family, etc.).	______
	II. LEARNING ENVIRONMENT--NUSTEP PROGRAM:	
	A. Describe at least two ways in which the NUSTEP Program:	
______	1. facilitates learning in your perferred style(s).	______
______	2. inhibits learning in your perferred style(s).	______
	B. Describe at least two ways in which the NUSTEP Program:	
______	1. individualizes instruction to meet the heterogeneous needs of your NUSTEP class.	______
______	2. could be changed in order to better meet the individual needs of your NUSTEP class.	______
	C. Identify at least two handicapping conditions which are or could be present in your NUSTEP class.	
______	1. Cite at least one change in the classroom arrangement that would be necessary in order to mainstream individuals with each of the handicapped conditions (identified above) in your class.	______
______	2. Cite at least two potential modifications of materials and/or format that would facilitate the mainstreaming of individuals with each of the handicapped conditions (identified above).	______

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Checklist con't
MODULE VI
ON CAMPUS WORK SAMPLE

Student My work sample contains the following:		Supervisor The work sample contains the following:
	II. LEARNING ENVIRONMENT--NUSTEP PROGRAM con't:	
______	3. Describe at least two examples of how objectives and assessment procedures used in your NUSTEP class could be modified to facilitate mainstreaming individuals with the handicapping conditions identified above.	______
	III. CLASSROOM TEACHER IN A CONSULTING SITUATION:	
	A. Identify at least one possible responsibility of the classroom teacher:	
______	1. in the referral process.	______
______	2. in the staffing process.	______
______	3. in implementing the Individual Education Plan (IEP) drawn up in the staffing.	______

B. Off Campus Work Sample

FOR THE OFF CAMPUS WORK SAMPLE YOU WILL:

1. READ THE CASE OF MARY.
2. ANALYZE THE CLASSROOM ENVIRONMENT of your TA setting relative to meeting Mary's needs.
3. ANALYZE YOUR TEACHING STYLE; or the one(s) to be used in teaching your unit, relative to Mary's needs.
4. In your Off Campus setting, IDENTIFY WHO WOULD BE INVOLVED IN A STAFFING/REFERRAL PROCESS for the case of Mary, and briefly describe their roles.

NOTE

1. In completing this work sample, assume that Mary is a handicapped student who is to be mainstreamed in "your" classroom (one similar to your TA setting) while you are teaching your unit plan.
2. In identifying the people involved in the staffing/referral process, use NETCHE Tape #2 as a reference. Note that in the Off Campus setting you may not be able to identify all of the roles/people presented in NETCHE Tape #2.

Checklist
MODULE VI
OFF CAMPUS WORK SAMPLE

Student My work sample contains the following:		Supervisor The work sample turned into me contains the following:
	I. ANALYSIS OF CLASSROOM ENVIRONMENT:	
______	A. Describe the classroom environment of your off campus (TA) setting.	______
______	1. Describe at least one modification, if needed, of the physical arrangement that would facilitate the mainstreaming of Mary. (How are the students seated? Are they in rows, or perhaps in a cluster of desks? If Mary's strengths are her personal/social skills, would one particular seating arrangement be better than another? Why?)	______
______	2. Describe the textbooks. Identify their reading level, and if needed, cite an example of how you would adapt the text materials to Mary.	______
	II. ANALYSIS OF TEACHING STYLE:	
______	A. If you were the teacher in your (TA) classroom, identify your preferred teaching style (i.e., mainly lecture, student notes, small groups, etc.).	______
______	B. Describe, if needed, at least two ways that you would change your teaching style for Mary.	______
______	C. Describe two ways you would choose to evaluate her progress. (Remember, she has poor eye-hand coordination. Would you give her a written test with only a short time to write the answers?)	______
	III. REFERRAL/STAFFING PROCESS	
______	A. In your TA setting report who would be involved in the referral and subsequent staffing for Mary.	______
______	1. Identify at least one responsibility for each of the persons you reported.	______

C. Skill Acquisition Section

Here you will find the skill acquisition sources for both the On and Off Campus Work Samples. You will note that the readings are grouped somewhat differently from the pattern in the other modules; they do not directly correspond to the headings on the checklist. It is anticipated that you will view all three NETCHE tapes (found under C. Job Roles) before completing the work samples. Also, you will need to read the case of Mary (found in 2. a. iii) in order to complete the Off Campus Work Sample.

1. Heterogeneous nature of classroom as a whole.

   a. Socioeconomic and cultural differences:

      i. The Way It Spozed to Be, J. Herndon, pp. 25-50 (book).
      ii. "Cultural Differences" (videotape).
      iii. "What is Poverty," Jo Goodwin Parker (article).
      iv. Mainstreaming: The minority child in regular classes, Jones (book).

2. Unique needs of mildly handicapped mainstreamed students.

   a. Range of individual differences:

      i. Psychology for the Classroom, Gibson, pp. 377-404 (book).
      ii. "Interpreting Measurement Statistics" and "Characteristics of Measuring Instruments" (articles).
      iii. "Mary: Multiple-Handicap Assessment" (article).

   b. Assessing teacher-learner style:

      i. "Learning Styles," Maryland Tape #7 (videotape).

   c. Job roles:

      i. Mainstreaming Exceptional Children: How To Make It Work, John A. Glover and Albert L. Gary, pp. 36-57 (book).
      ii. Exceptional Children in Regular Classrooms, Maynard C. Reynolds and Malcolm D. Davis (Eds.), pp. 64-70 (book).
      iii. Mainstreaming: Origins and Implications, pp. 5-7 (book).
      iv. Trends in Education, Maynard C. Reynolds, pp. (book).
      v. NETCHE Tapes, I, II, and III (videotape).

Mainstreaming Physically

Handicapped Students*

Debbi Swazuk

The topic of mainstreaming has been in the limelight for many months. Due to the recent passage of laws which give physically handicapped children the right to receive an education in the least restrictive setting available, mainstreaming has been forced upon the public. This pressure from the government has taken too long to materialize. Unfortunately, for years physically handicapped students have been subjected to segregation in "special schools" where they often received inadequate education, especially in science. Since this working conference is on science education for handicapped students, I would like to direct my attention to what I believe are the problems, solutions, and benefits of mainstreaming physically handicapped children into the academic field of science.

I view mainstreaming as a desirable alternative to segregated special education settings, which I believe hinder more than facilitate science education. I specifically refer to the special education teachers whose degrees enable them to touch lightly upon all the academic subjects, but not to provide intensive instruction in particular subjects unless a certain subject is a favorite. In addition, the student is usually faced with minimal, if not totally absent, lab equipment and space, and with inadequate learning conditions.

As welcome as mainstreaming is, it nevertheless poses problems for all involved. As a consequence of long established myths, many believe that the handicapped student cannot function physically in scientific fields. The physically handicapped student may in fact be spastic, have weakness in the hands, and lack coordination and control. This is why they are labelled physically handicapped. However, fields such as Occupational Therapy can help in developing devices and other means to enable the student to overcome physical barriers, and vocational counselors can help pave the way for emotional adjustment and act as go betweens when difficulties arise.

*The preparation of this paper was supported in part by a grant from the National Science Foundation.

It is unfortunate that society has taken so long to accept the handicapped individual as an equal, as it leaves the teacher who is faced for the first time with a physically handicapped child unprepared to cope emotionally or educationally. The crux of the problem for the teacher is facing the situation and dealing with his or her own emotional reactions. This must occur before any successful mainstreaming can begin. Initially, the teacher may experience a feeling of inadequacy due to a lack of familiarity with the student's disability and not knowing what to expect with regard to the child's strengths and limitations (a child's records may not always give an adequate description, for example, the report might say "needs cuff for handling pencils and can write for ten minutes," but that may mean 10 minutes with a 10 minute rest period, followed by resumption of writing for another 10 minutes). Other factors include how much time the teacher has had for preparation before the student's arrival, what kind of inservice training the teacher has received, how serious the disability is, and the extent to which the child's mobility is impaired.

The problem of lack of information, combined with the teacher's own nervousness about the on-coming situation, can easily compound the teacher's feelings of inadequacy. Teachers may be afraid of physically or emotionally "hurting" the student while teaching. Since they do not understand the full extent of the disability, they don't know what limitations may exist. Also, there is the ever present question of how the student reacts to his own disability, especially if it is newly acquired due to accident or recently diagnosed disease. Teachers also run the risk of embarrassing the child or hurting his feelings. This can cause tension in the classroom and hinder the learning process for all concerned. Such situations can become quite dangerous emotionally if not dealt with properly.

Since it is easier to learn and teach if the working relationship is sound, overcoming feelings of inadequacy and fear is a priority. If they are permitted to mushroom and become threatening, and the teacher feels he is not being assisted in dealing properly with the situation of mainstreaming the physically handicapped child, anger may develop among all involved - school personnel, parents, and last, but foremost, the handicapped child and his fellow classmates. The teacher begins to feel the school has carelessly thrust him into an unreasonable situation that he cannot adequately handle. I believe the teacher's anger at the school, the parents, and the child is justifiable if there is not substantial information about the child, the child's parents, and their emotional and physical ability to handle the situation and consultation is not arranged before mainstreaming begins.

Once parents, children and teachers are on a consultation basis with each other and doctors and other professionals are involved, the mainstreaming process will begin to prosper. Informal meetings between the teacher and the parents and student prior to the student's arrival in the class would relieve tensions for both and prepare rather than shock the system. The teacher can become acquainted with the child, his limitations and strengths, develop familiarity with the disability, and make any physical changes needed in the classroom before the first day of classes. There are always changes made during the course of the semester, but the physically disabled student will not feel as alienated when changes are gradually made as situations arise and will be more comfortable if changes are already established in the classroom before his arrival. As time goes on the teacher, physically handicapped student, and his peers, with the help of consultants, can work together and find solutions to the problems they experience.

If the school provides the teacher with orientation before the arrival of the handicapped student, involving vital medical and psychological information on the disability the student has, as well as information about resource personnel and programs that may be utilized, the teacher's fears may be alleviated. I believe a colloquium style discussion would help the participants explore their feelings about the situation, share previous experiences with the disabled, and find possible solutions to old and new problems. Through such an exchange of information, all can benefit.

Another major problem teachers experience is discipline. It is easy for them to feel sorry for disabled students and give them more freedom to misbehave than the nondisabled students. This can breed contempt and jealousy among the student's non-handicapped peers. This desire to compensate for the student's physical handicap with more freedom in class must be overcome because the potential damage surely surpasses the benefits.

Of great importance in teaching any student, and especially the physically handicapped, is maintaining humor. Humor is something that can't be taught or learned through orientation; it just has to come from within. But it needs to be there for the teacher to get through the many frustrating situations that he or she will face when mainstreaming the physically handicapped. There will be times when awkward situations will develop and the devices used to overcome problems backfire. If the situation calls for a laugh, everyone should feel free to express it. I can't express enough that everything cannot be taken seriously.

When the physically handicapped are mainstreamed into science classes, it is not only the teacher who is confronted by problems. Non-physically handicapped students are also faced with a lot of new experiences when the disabled are included in their classes. Some of these experiences may seem overwhelming to the non-handicapped students. First, they may need to overcome their reaction to the outward differences between some physically handicapped and themselves. Sometimes these differences can be quite grotesque by society's standards, and they may be frightening and revolting to the non-handicapped. These students need to be given time to cope with the physical differences in their peer. They need time to realize that their peer may look different, but that basically, the student is the same as them, with similar hobbies, likes, and dislikes, surprising as it may be to the "sheltered" non-disabled.

To help facilitate overcoming reactions to physical differences, it would be beneficial to all concerned to have a student orientation as well as orientation for teachers. Ideally, this orientation would occur before the students' first day, if the mainstreaming takes place after the beginning of the new school year. The handicapped student could come in and everyone could get better acquainted. The students could discuss their own interests, and explain to the new student what they've been learning in class. Also during this time the teacher could explain what is expected of the students in the class, for example, doing an experiment each week. This time would be excellent for explaining limitations that will occur in the science classroom and finding solutions to problems. For example, the student may have weakness or spasticity in the upper extremities or a sensory handicap and may need to borrow someone's notes or have help in doing exoeriments. The teacher might assign all the students, including the new one, to think of some alternatives for doing assignments, experiments, and so on. The teacher could also ask for volunteers to help the student when needed. Through such a student orientation, the awkwardness that is experienced by new handicapped students can be eased.

Great emphasis must be placed upon helping the students overcome their fear of hurting their physically handicapped peer. They must realize that we don't break that easily, and that if the student feels there is a danger of being injured, he will voice it to the others. I emphatically feel it is the disabled student's job to be frank and open about the disability and its limitations. If the child learns early, as trite as it may seem, that "honesty is the best policy," he will have a better chance of being accepted for who he is, a person who happens to have a disability.

Another reaction non-physically handicapped students may show is testing the new student through ribbing and hazing. They want to see if their peer will fight back, and if he has spunk. Like all children, they want to know if this new student likes to be kidded. I feel this is good because it enables the handicapped child to interact naturally with his peers and enables all to become more at ease. The students are in school not only to receive a sound science education, but to learn about human nature, to better understand themselves through interaction with others, and to learn how to get along with others. But I would like to also stress that the teacher should be ready to intervene if it appears that the other students are becoming cruel or that the handicapped child is not able to handle the situation.

Now I would like to discuss the handicapped student's reactions to being mainstreamed. The student will be as nervous as any new student, but his anxiety may be compounded by his true "differences." He doesn't know how the other students will react to his disability. The disabled student may also be embarrassed by the disability if it has aspects that are not socially accepted, such as the drooling that cerebral palsied children often exhibit or occasional incontinence caused by certain conditions. In such instances, I suggest that the student merely be helped to get the situation under control as well as possible. He might like to help explain it to the class, so that the others will understand that it is beyond the student's control and learn to accept him for who he is.

The handicapped student may also experience a fear of failure. This is prevalent among handicapped students who have gone to "special schools" where they live a rather sheltered existence. There is very little threat of failure there, and competition is practically nil. This is one of the worst aspects of the special school system. The child doesn't learn how to handle competition until he goes to college, thus making the transition from a special school to college an exceedingly difficult task.

This lack of competition in special schools is another reason why mainstreaming is essential. Furthermore, the quality of science education is much better in a regular school setting, where the child is usually taught by a teacher who has expertise in science rather than a degree in special education. The child's fear of failure is quite real to him, and failure becomes more probable the longer the schools wait to do mainstreaming. As it is now, very few physically handicapped are academically equipped to go into one of the natural or physical sciences if they have attended special schools.

A major result of mainstreaming can be an increase in the handicapped student's independence. By helping the student develop the skills to perform in a science course, the teacher can develop his independence. This can be achieved through low cost environmental changes and the use of helping devices in the labs.

For example, an arm-raising device has recently been invented by John Poulton, a student at Rensselaer Polytechnic Institute, to help a biology student stricken with muscular dystrophy. By just using his fingers to operate a switch which controls the arm-raising device, the student is able to raise his arm to pour liquids in the laboratory. As a result of this invention, the student will be better able to actualize his hope of becoming a physician. Architectural barriers in the science classroom can be overwhelming to the handicapped student, but there are easy solutions to these otherwise catastrophic problems. For example, students who are confined to wheelchairs find it almost impossible to use the regular-size lab tables, since they are much too high. This problem can be overcome by the use of portable ramps that the student can wheel up and sit upon in his wheelchair on a platform equal with the table, or by use of a hydraulic pump action to heighten or lower tables.

The buddy system can also be used to enhance the handicapped student's ability to perform in science courses. One problem the physically handicapped student may encounter is weakness or spasticity of the upper extremities which limits his ability to do class assignments. This difficulty can be overcome by pairing the handicapped student with a non-handicapped peer so that they can do experiments together. The buddy system also works well with the sensory handicapped. The blind student can have the science experiment explained by his partner, while the deaf student can stand opposite a hearing student to follow each step. Since the deaf will have difficulty reading lips and doing the experiment simultaneously, they need only to follow their partner who has stationed himself opposite to complete the assignment and understand the process. In addition, all the disabled could use the buddy system to supplement their class notes.

Another method that could be utilized, especially with the deaf, is to hand out an outline of the experimental procedure the day before the class. This way the student need only glance at the outline to follow the teacher. Another helping device that could be utilized for the blind, particularly in biology classes, would be to supplement their inability to see the various parts of an animal by using a plastic model of the animal's internal organs. This would be similar to models of the human brain that are presently used in science classes. The blind student would be able to run his fingers over the model and thus comprehend more fully what the others are seeing through dissection. These are just a few practices that would aid in teaching science to the physically handicapped. Solutions to the problems handicapped students face can be found if a little time, effort, and usually a minimal amount of money are invested.

Everyone can benefit from mainstreaming physically handicapped students into science classes in regular schools. Those involved can learn to accept others for who they are. Mainstreaming tremendously reduces the stigma of being handicapped and closes the perceived gap between the handicapped and the nonhandicapped, once both groups realize that the differences are quite minimal. After the handicapped student has been in a class for awhile, the teacher and the other students realize that the handicapped don't want or need a lot of extra help. The handicapped want to achieve as much independence as possible, and will let others know their limitations. Through all of this, everyone is able to develop interaction skills in a variety of situations with a variety of people. The primary reason for mainstreaming is that it enables the handicapped to learn in a competitive atmosphere which prepares them to function better in our competitively oriented world. In addition, it allows them to receive a more adequate science education and possibly to choose a science career. Mainstreaming of the physically handicapped is essential to open the doors to a career in science that have been shut against them for too many years.

LUNCHEON, April 3 - Mainstreaming and the Law

"MAINSTREAMING AND THE LAW" - Frederick Weintraub

A summary of the luncheon remarks made by Frederick Weintraub is presented below.

Interpretation of Education of the Handicapped Act, P.L. 94-142, began with a discussion of semantics and a definition of terms. For purposes of P.L. 94-142, children with disabilities are defined as handicapped if they require special education under any circumstances. Special education is specially designed instruction to meet the unique needs of the child. The degree of specially designed instruction will vary depending on the child and will vary with the ame child over time. Related services are defined as those services necessary to support the specially designed instruction. Several examples were cited to distinguish related services from special education.

The central feature of P.L. 94-142 is Provision for the Individualized Education Program (IEP) which includes the handicapped student's unique instructional problems and needs along with short term instructional objectives. The IEP can serve as a tool to find out whether the services being provided are working and what adjustments need to be made.

According to Mr. Weintraub, mainstreaming does not mean that all handicapped children will be entering the regular classrooms. The law provides that handicapped children should be educated with non-handicapped children to the maximum extent appropriate for the child. The law requires that handicapped children have available to them a free, appropriate public education in the least restrictive environment. P.L. 94-142 serves as a vehicle to move children who do not belong in special institutions out of the institutions and into less restrictive settings.

To provide more science education to handicapped students, school must provide adequate IEP's. There is almost no mention of the sciences in the IEPs written in the last year. Educators must look at not only the quantity, but also the quality of the kinds of programs they are developing for children. P.L. 94-142 is a simple statement of how the educational system should optimally function for children.

"MAINSTREAMING AND THE LAW" - Patricia Morrissey

A summary of the luncheon remarks made by Patricia Morrissey is presented below.

Two assumptions underlie "least restrictive environment" provision of P.L. 94-142: 1) that proximity of handicapped students to non-handicapped students is a good idea; and 2) proximity is a critical ingredient if a handicapped child is to reach his or her potential.

Section 504 of the National Rehabilitation Act of 1973 reinforces and expands on the concept of equal opportunity presented in P.L. 94-142. Unlike P.L. 94-142, Section 504 is mandatory in civil rights legislation and recipients of HEW funds must comply with rules and regulations addressed in that section.

The provisions of 504 cover the handicapped individual throughout most of his life. They prohibit discrimination on the basis of handicap in education, employment, and health and welfare services. In summary, 504 provisions require HEW recipients to provide an equal opportunity for the handicapped individual: to obtain the same results, to gain the same benefits, and to reach the same level of achievement as his or her normal counterpart. Section 504 deals with: employment practices; program accessibility; preschool, elementary and secondary education; post secondary education; and health, welfare and social services. Section 504 also addresses compliance, monitoring, and self evaluation requirements.

Implications of the federal mandate will depend on: public awareness; system-wide coordination; broad based in-service training opportunities; and consideration of potential consequences of specific accomodations to the handicapped.

The implication for science and the handicapped student include the following: 1) Vocational counselors should include a science option for the handicapped. 2) Program modification to serve handicapped students must include sensitivity to individual differences and preferences. 3) Program modification must balance equalization of opportunities against the practical constraints of certain types of modification.

In conclusion, given the pervasive nature of recent legislation and the special needs of handicapped students with normal or gifted potential, three goals seem imperative: 1) the establishment of systems for determining priorities for serving handicapped students through science; 2) development of decision rules and standards for judging efforts and facilitating change; and 3) dissemination of recommendations, status reports, and effective practices to critical audiences in a timely manner.

PANEL III: CURRENT PRACTICES RELATING TO AUDITORIALLY HANDICAPPED STUDENTS

Participants:

Dean R. Brown	"Teaching Science to the Hearing Impaired: A Research and Review of Pertinent Literature"
Harry G. Lang	"Some Educationally Significant Traits of Hearing-Impaired Physics Students and Implications for Teachers in the Mainstream"
Dennis W. Sunal	"Science Curricula for the Young Hearing Impaired: Present State of the Art"
Henry Vlug	"Science Education for the Deaf"

Reactants:

Daniel D. Burch	"A Report from the National Demonstration School for the Hearing Impaired: Science Curriculum Development"
Doris E. Hadary	(Paper in Special Panel)

Virginia Stern, Chairperson

TEACHING SCIENCE TO THE HEARING IMPAIRED:
A RESEARCH AND REVIEW OF PERTINENT LITERATURE

Dean R. Brown

This presentation will attempt to give an update on the current "state of the art" of science instruction of the hearing impaired by reporting the findings of an extensive search of the literature on this topic. Through the efforts of Ben Thompson (39)* and his work with the Science for the Handicapped Association (SHA), an excellent reference entitled "Science for the Handicapped Bibliography" has provided valuable assistance in the preparation of this paper.

Although it is difficult to establish the exact number of handicapped students in the United States between the ages of 5-18 years of age, it has been estimated by several government agencies that based on 1978 population estimates, there are between six to nine million youths with some type(s) of handicapping conditions, Gearheart, Weishahn (15). Approximately 0.6-0.8% of the school population or 330,000-440,000 students would be identified as having a type of hearing loss, enough to be classified as hearing impaired. For the purposes of this paper, the term hearing impaired will be used to include the entire range of auditory impairments, inclusive of the deaf child as well as the child with a very mild loss, Moores (23). Deaf and acoustically impaired will also be used if these terms are so used by the referred authors. Davis (10) and Moores agree that there is much confusion among professionals with the inability to reach consensus on terminology, but both agree on the term hearing impaired as a functional definition.

* See references

At the present time, there are no national science curricula designed specifically to teach the hearing impaired, so it is the role of the science teacher or special educator to adapt existing methods and materials to accommodate the language impairment that deafness usually involves. As this paper will indicate, some investigators have successfully adapted programs such as Science Curriculum Improvement Study (SCIS), Science-A Process Approach (S-APA), Elementary Science Study (ESS), and Biological Sciences Curriculum Study (BSCS) ME NOW with hearing impaired students, but the majority of teachers are still searching for materials, methods and curricular aids to utilize in making science a successful experience for handicapped youth.

The language performance of the average hearing impaired child compared to that of his normally hearing peers demonstrates an ever-increasing gap in vocabulary growth, concept formation, and ability to comprehend and produce complex sentences, Davis (10). Because language and speech are seen as the major need for hearing impaired youth, content areas such as science and mathematics receive low instructional priority. Moores (23) suggests that often class time designated for academic subjects is devoted entirely to speech and language remediation. Since most teachers of the hearing impaired have not been trained in subject matter, just as most science teachers have not been trained in special education, the tendency to sacrifice content is intensified. Furth's (13) criticism of deaf education deals mainly with this intellectual neglect, and is the basis of this appeal for more cognitively based learning experiences. Problems with communication are further complicated by the continued controversy over suitability of modalities or channels of communication, auditory/aural versus visual.

What does the preceding say to us as science educators regarding the education of our hearing impaired youth? How do we fit the uniqueness of the processes of science into a most worthwhile program, be it in the residential, day school, resource room, or in a mainstreamed science classroom? Science educators have an inherent advantage over teachers of other content areas due to a positive motivation and a high occurrence of hands-on activities in most materials and activities used, Egelston, Mercaldo (11). Hearing impaired children are scientists by disposition according to Owsley (26). They ask questions and use their remaining sensory channels as well as reasoning powers to explore their physical environment. Science can be of great assistance to the teacher of the hearing impaired in the development of cognitive skills and language because of the high interest level and great variety of ideas to be explored. Jerome Bruner (6) in describing the translation of experience into language states: "But it is obviously not language per se that makes the difference; rather, it seems to be the use of language as an instrument of thinking that matters, its internalization. The very young child uses language almost as an extension of pointing, and recent work shows that the likelihood of a word's use in the early linguistic career of the child is vastly increased if the object is either in hand or in direct sight."

Athey (2) implies that language cannot always be relied upon to convey concepts to a child. Piaget (28) states that children may verbalize without understanding, just as they may understand without being able to verbalize. He has demonstrated that the ability of children to deal with broad concepts depends on their direct sensory experience. Mary Budd Rowe (35) suggests that in order for language to develop rapidly in the context of science activities, it is necessary to have all data available to every child. Hearing impaired youth can profit from a somewhat prolonged exposure to directed experiments designed to focus attention on patterns of interaction in physical and biological systems, and can develop more elaborate forms of thinking with early success in reasoning about what they observe and how systems respond to

Using the survey data the following summary description of the characteristics of sample H.I schools science curricula can be made.

1. About 20% of the schools teach no regular science.

2. About 50% teach basically unmodified public school science.

3. About 30% have developed a program specifically modified for the hearing impaired.

4. About 17% are oriented toward or deliberately teach science process or inquiry skills.

5. About 20% attempt individualized, self paced or some sort of structured sequence other than topic or unit approach to a whole group.

6. About 15% have specific strategies of teaching and evaluating science for the hearing impaired.

7. More curriculum development for the hearing impaired is occurring in midwest schools than in other regions.

If this sample is typical of all schools specifically designed for the hearing impaired, the authors conclude that science curricula in a majority of schools are not providing minimal help in educating the young hearing impaired. The rationale and needed changes for this judgement are discussed next.

<u>State of the Art-Analysis</u>

Regardless of the type or source of the science curriculum, schools for the hearing impaired are consistently faced with decisions regarding the selection, development and modification of effective science material. Typically, this is done in a superficial manner with little thought given to a complete analysis of the materials in question. In an effort to structure curriculum decisions in selection or development, we are proposing a set of guidelines to be employed for analysis of curricula before the decision is made to select or continue the use of school science curricula.

The guidelines have been generated around a basic conceptual approach to curriculum advocated by Ralph Tyler. They are centered around four fundamental questions which must be answered in developing any curriculum and plan of instruction. These are:

1. What educational purposes should the school seek to attain?

2. What educational experiences can be provided that are likely to attain these purposes?

3. How can these educational experiences be effectively organized?

4. How can we determine whether these purposes are being attained?[4]

Additional physical description and analysis components were added to complete the guidelines (see Table 2). The resulting instrument "Analysis Guidelines for Science Curricula for the Hearing Impaired" is presented below with added parenthetical comments to further delineate the subcategories.

In keeping with the nature of this convention, we are presenting this in order to solicit your feedback to make this guide more complete and generalizeable to all professionals involved with teaching science to the hearing impaired. The analysis process involving the following "Analysis Guidelines" is designed to be used after a review of all the components of a particular curriculum. All materials should be inspected since, typically, various components support each other. Following this review, the analyst should briefly address the categories listed below, which are appropriate, in the format which is described.

Analysis Guidelines for Science Curricula for the Hearing Impaired

1. Science curriculum description and development

   A. Title:

   B. Author or institution:

   C. Publisher:

   D. Age levels:

   E. Science content: (topics, themes, problems) list them.

   F. Developmental process and field evaluation: describe.

   G. Curriculum components: list with cost.

   H. Current extent of adoption in schools for the hearing impaired.

I. Teacher training recommendations (recommended, provided for workshop available, teacher's guide with videotape available).

J. Time needed for lesson preparations (long-range planning needed, extensive preparation, lesson review only).

K. Availability of laboratory materials (provided with program, supplementary purchased from different sources).

L. Storage considerations.

M. Others.

2. What are the goals of the science curriculum?

A. Purpose of the curriculum design (to meet state requirements, to enhance the language development program).

B. What are the goals for the learner? (to develop inquiry skills in students, facilitate cognitive skills).

C. Target student types (hearing impaired, physically handicapped).

D. Special hearing impaired emphasis (hard of hearing, deaf, multi-handicapped - MHHI).

E. Communication system emphasis (aural/oral, total communication, cued speech).

F. Goals specifically for HI (specific science content, language expansion, career education).

G. Designated use in schools (total curriculum, supplementary, enrichment).

H. Others.

3. How is the science content organized?

A. Scope of the curriculum (breadth, depth).

B. Curriculum sequence (hierarchical, isolated topics).

C. Lesson organization (units, modules or lesson cluster, daily lessons).

D. Concept and language sequence (hierarchical, spiral, many examples through recycling).

E. Theoretical basis (Gagne, Piaget).

F. Curriculum emphasis (process, content, mixed).

G. Purpose of supplemental activities (for advanced work, remedial, generalizing).

H. Content focus (objects or systems, patterns of interaction or relationships).

I. Lesson flexibility (short lessons to allow for expanded time factor, extensive lessons which may be appropriately divided).

J. Allowance for current science concerns (environmental concerns, metric concepts).

K. Others.

4. What methods are used in teaching?

A. Method of presentation (individualized, group).

B. Presentation style (self paced, learning center, demonstration).

C. Presentation sequence -- outline the sequence (pre-diagnosis, activities, overall group evaluation, individual evaluation).

D. Instructional methodology (rote, passive, activity-oriented).

E. Language presentation style (natural language, transformational grammar (structural approach).

F. Presentation emphasis for HI (Structured simple directions, students assemble apparatus, extended time possible for data interpretation).

G. Specific identification of problem vocabulary. (Pre-teaching of vocabulary, structured plans for terminology presentation).

H. Presentation cues (visual orientation of materials, speed of presentation).

I. Others.

5. How is learning evaluated?

A. Purpose (achievement, diagnostic).

B. Types (structured test situation, observation of classroom behavior).

C. Characteristics (paper and pencil, task performance, cognitive, affective).

D. Reporting system (anecdotal report, checklist, grade).

E. Others.

6. How do the design components fit into a total effective curriculum?

Summarize the statements above evaluating the curriculum as to its applicability and projected effectiveness for the teaching of science to hearing impaired students in your local setting. Each component should be addressed as to the suitability of the curriculum for the students, teaching staff, administrative concerns, and physical plant. Comparisons should be made with other curricula. Finally, make a statement as to the desirability of this curriculum for your school setting.

The total process in which the Analysis Guidelines should be used involves the selection of a science committee, selection of appropriate science curricula, performing an analysis on each curricula using the Analysis Guidelines, and a comparison of the analysis reports by ranking of each of the selected curricula for a final decision.

Experience in using the Analysis Guidelines would build a frame of reference by which educators would be able to intuitively evaluate science curriculum effectiveness for the hearing impaired. To date, intensive use of Analysis Guidelines Instrument on more than a dozen curricula in use today for the hearing impaired, indicates that no commercially produced materials are available which are specifically designed for the hearing impaired. These curricula generally assume too large of a linguistic repertoire, consist of activities which need to be selectively supplemented and make few allowances for visual representation of taped materials. Some can be successfully modified, such as SCIS. Analysis of locally designed science curricula for the hearing impaired indicated that all had structural defects or problems that apparently may seriously effect successful science teaching with the hearing impaired. Current research, principally that of Hans Furth, seems to indicate that hearing impaired children develop cognitively comparatively the same as their normal hearing counterparts.[5] These locally developed curricula appear to introduce high level cognitive tasks at too early an age.

Summary

Given the present state of the art, future science curricular development or modification of curricula need to take into account the issues addressed in the guide more thoroughly, whether as a help for curriculum development or curriculum selection. An analysis scheme such as the Analysis Guidelines is needed for a structured attack on producing and selecting effective science curricula for the hearing impaired.

Footnotes

1. Row M. B., Teaching Science as Continous Inquiry, McGraw Hill, N.Y., 1973, 411.

2. Ibib.

3. Ob, Cit.

4. Tyler R. W., Basic Principles of Curriculum and Instruction, The University of Chicago Press, Chicago, 1949.

5. Summary of latest research done by Hans Furth at Catholic University in Washington, D.C. over the last three years.

Sample Schools

Arizona State School for Deaf and Blind
Arkansas School for the Deaf
Boston School for the Deaf
California State School for the Deaf, Berkeley
Central Institute for the Deaf, St. Louis, Missouri
Clark School for the Deaf, Massachusetts
Colorado School for the Deaf
DePaul School for the Deaf, Pennsylvania
Florida School for Deaf and Blind
Georgia School for Deaf
Governor Baxtor School for Deaf, Rhode Island
Illinois State School for the Deaf
Hawaii School for the Deaf
Idaho School for the Deaf and Blind
Iowa School for the Deaf
Kansas State School for the Deaf
Kutzenbach School for the Deaf, New Jersey
Kentucky School for the Deaf
Lincoln Developmental Center, Illinois
Louisiana State School for the Deaf
Maryland School for the Deaf
Minnesota School for the Deaf
Missouri School for the Deaf
Nebraska School for the Deaf
New Mexico School for the Deaf
New York School for the Deaf
Central North Carolina School for the Deaf
Eastern North Carolina School for the Deaf
Oklahoma School for the Deaf
Oregon School for the Deaf
Porterville State Hospital, California
North Dakota School for the Deaf
Pennsylvania School for the Deaf
Rochester School for the Deaf, New York
Scranton State School for the Deaf
St. Joseph School for the Deaf, Missouri
Margaret Sterck School for Hearing Impaired, Delaware
St. Mary School for Deaf, New York
Texas School for the Deaf
Utah Schools for the Deaf and Blind
Virginia School for the Deaf
Virginia School for the Deaf and Blind
Western Pennsylvania School for the Deaf
West Virginia Schools for Deaf and Blind
Wisconsin School for the Deaf
Wyoming School for the Deaf
Kendell Demonstration School, Washington, D.C.

Appendix

Response Sheets for Analysis Guidelines for Science Curricula for the Hearing Impaired

Complete each section briefly describing component and/or evaluating effectiveness.

1. Science Curriculum description and development

A. Title ____________________

B. Author or institution ____________________

C. Publisher ____________________

D. Age levels ____________________

E. Science content

F. Developmental process and field evaluation -- describe.

G. Curriculum Components -- list with cost

H. Current extent of adoption in schools for the hearing impaired.

I. Teacher training recommendations

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schools

3. How is the Science Content organized?

A. Scope of the curriculum.

B. Curriculum sequence

C. Lesson organization

D. Concept and language sequence

E. Theoretical basis

F. Curriculum emphasis

G. Purpose of supplemental activities

H. Content focus

I. Lesson flexibility

J. Allowance for current science concerns

K. Others

4. What methods are used in teaching?

A. Method of presentation

B. Presentation style

C. Overall presentation style

D. Instructional methodology

E. Language presentation style

F. Presentation emphasis for HI

G. Specific identification of problem vocabulary

H. Presentation cues

I. Others

5. How is learning evaluated?

A. Purpose of evaluation

B. Types of evaluation suggested or supplied

C. Characteristics of suggested evaluation

D. Reporting System

E. Others

6. How do the design components fit into a total curriculum?

Summarize preceding statements by evaluating relationship between components and with the elements in your school setting.

Effectiveness of this science curriculum in your school setting.

SCIENCE EDUCATION FOR THE DEAF

Henry Vlug

Hearing impaired students comprise a well defined and sizeable group of students. Compared to many of the other handicaps this group has been and continues to be relatively well served by educational programs.

As of October 1, 1976 (American Annals, 1977) there were 44,949 students in 671 schools and classes. These had a total educational staff of 13,793 including 7,743 instructors. 15,043 (33%) of the students had "residential" status as compared to 29,906 (64%) students with "day" status. 6,008 (13%) were mainstreamed and an additional 7,511 (17%) were partially mainstreamed. 10,859 (24%) of the students were multiply handicapped--i.e. had a handicap in addition to deafness.

Achievement

The shortcomings of standarized tests, especially when used with minority groups such as the deaf, are well known. Still the scores do give some indications of the magnitude of the problems facing teachers of the deaf. The deaf consistently score below their hearing peers on achievement tests. Figures 1-3 (Trybus and Karchemer, 1977 and O.D.S. no date) demonstrate this clearly for three subtests of the Standarized Achievement Test. Reading comprehension is generally agreed to be the most critical area for school achievement for the deaf. Math computation, besides being of obvious relevance, is the area in which hearing impaired children reach their highest test scores. Scaled scores instead of grade levels are used because scaled scores are more appropriate for combining scores across test levels. A scaled score of 132 is equal to or grade equivalent score of 3.2 and a scaled score of 182 is equal a grade equivalent score 8.2. The other scaled scores correspond less closely to grade equivalent scores.

Figure 1: Reading Comprehension Scores National Distribution for Hearing Impaired Students

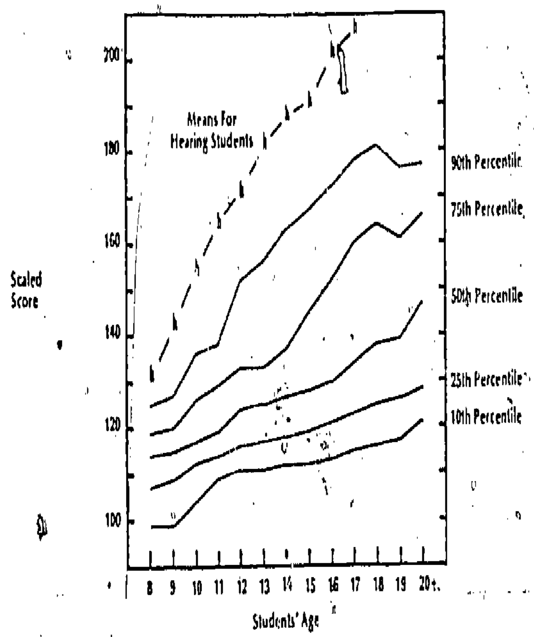

Figure 2: Mathematics Computation Scores National Distribution for Hearing Impaired Students

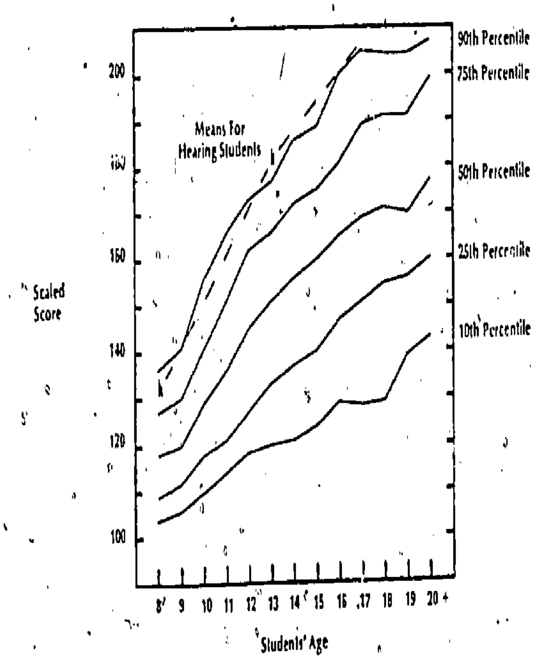

Figure 3: Science Scores National Distribution for Hearing Impaired Students

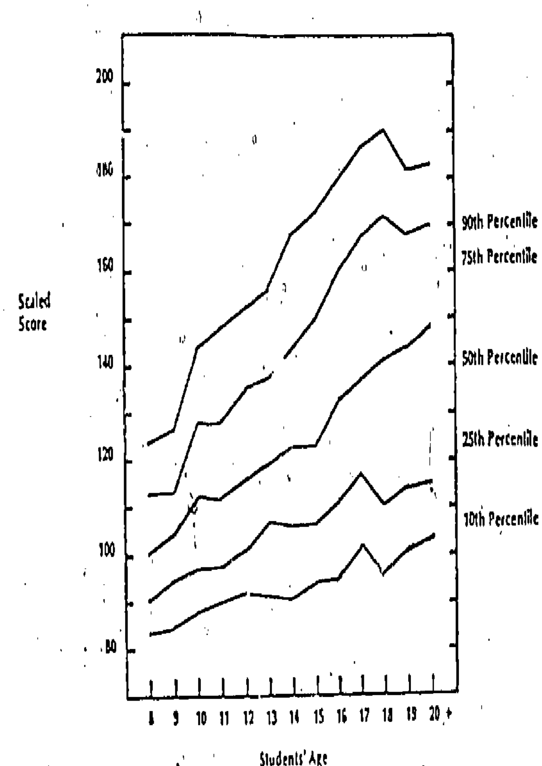

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Figure 1 shows that the median (50th Percentile) reading score at its highest point, is 147 (grade equivalent of about 4.5). Thus half the students at any age read less than a mid-fourth grade level. Even the high-achieving group (90th Percentile) reaches only about an 8th grade level. The low-achieving group (10th Percentile) reaches only about a 2nd grade reading level at its highest point. In more concrete terms this means that even the high achievers will have difficulty reading science texts written for their hearing peers. When working with low achievers you meet the students who need help in spelling "car."

The mathematic computation scores (Fig. 2) are a bit brighter. The high-achievers reach about the same level as the means for hearing students. The median score reaches about a 7th grade level. Even the low-achievers get up to about a 4th grade level.

The science subtest scores (Fig. 3) are similar. The high achievers get to the 8th grade level. The median gets up to the 4th grade level. The low-achievers don't go over the 1st grade level.

Deaf Scientists

In spite of the low achievement scores on tests, quite a few deaf people become scientists. While there is no reliable data on the number of deaf scientists there are some indicators. Thus, 6.6% (versus 10.6% for the U.S. population) of 7,920 deaf workers were found to be "professional, technical and similar workers" (Lunde and Bigmen, 1959). However, most (3.6%) of them were teachers. The national census of the deaf found 14.5% in professional and related services industries while 9.2% of the males and 8.1% of the females were classified as being in the professional and technical occupational category (Schein and Delk, 1974). A study of 87 deaf professionals (other than teachers) found 23 to be in Chemistry, 25 in Engineering, 7 in other sciences for a total of 55 (or almost 2/3) (Crammate, 1968). An additional 9 were in Mathematics or Statistics for a total of 64 (or almost 3/4 of the professionals).

Science Curriculae

Science curriculae for deaf students are to a large degree written by individual teachers (Table 1) (Rosen, et al, 1975). Teachers also have a very large degree of responsibility for curriculum development, textbook choice and sequence of presentation (Table 2). This individual responsibility results in a large number of different programs or textbooks being used (Table 3). The Concepts in Science Series is popular through the 7-8 grade level. Although the survey was made during a time when the use of the new science programs (ESS, AS&PA, SCIS, etc.) developed during the 1960s was near its peak (1972-1973) very few teachers reported using these programs.

Table 1. Sources of Written Science Curricular

Individual teachers independently	67.8%
School	23.9%
City or County	13.9%
State	7.2%
National funded project	7.2%
Total	120.0*

*Total exceeds 100% because respondents reported different sources for different parts of the curricula.

Table 2. Degree of Teacher Responsibility for Curriculm

Area of responsibility	Number of Respondents	Degree of Total	Responsibility Substantial	Very slight	None
Curriculum development	183	46.4%	45.4%	6.0%	2.2%
Testbook choice	181	39.8%	39.8%	13.3%	7.2%
Sequence of presentation	187	65.8%	28.9%	3.7%	1.6%

Table 3. Programs and Textbooks Used by Science Teachers

Level	Number of Respondents	Number of Different Programs and Texts	Number of Teacher-Made Programs or Texts	Most Popular Program or Text
K-3	49	25	5	Concepts in Science (11)
4-6	55	28	6	Concepts in Science (11)
7-8	55	39	0	Concepts in Science (9)
9-10	58	39	4	Modern Biology (7)
11-12	39	28	2	Pathways in Science Chemistry & Physics (6)

Science Teacher Qualifications

Table 4 (Rosen, et al., 1975) summarizes some relevant aspects of qualifications of science teachers for the deaf. More than half of the teachers had at least a Masters degree. More than half had taken a science methods teaching course. Less than a quarter had received more than 20 credit hours in undergraduate level science courses. Almost all had some kind of teacher's certificate. Of the 139 respondents who reported having certificates in a content area 34% were certified in science but this is equal to less than 25% of all 195 respondents.

Table 4. Science Teacher Qualifications

Category	Number of Respondents	Percent of Respondents in this Category
Bachelors degree	195	44
Masters degree	195	56
Science method teaching course	195	54
Council on Education of the Deaf certificate	175	49
More than 20 hours in undergrad science	186	22.5
Some graduate work in science	186	61.5
More than 20 hours in graduate science	120	9
State certificate	195	93
State certificate for science	139	34
State certificate for special education	184	31
State certificate for ed. of hearing impaired	184	70

Model Secondary School for the Deaf

In partial response to the need for leadership in developing curricula (including science) for the deaf, Congress in 1969 established the MSSD. The MSSD is charged with developing and disseminating curriculum materials for the deaf and also with providing instruction for a student population of up to 600 (enrollment in 1977-78 was approximately 170).

MSSD has eight science instructors who are working to meet the charge of development, dissemination, and instruction. MSSD also has a staff of curriculum development and [illegible] specialists to assist instructors in their development work. Most of [illegible] work of these specialists has gone into areas other than science, partiall[illegible] response to the lower priority educators of the deaf assign to science (Cu[illegible], 1976; Summers, et. al., 1977).

None of MSSD's science instructi[illegible] [illegible]rials are ready for dissemination at this time and there is no indicati[illegible] [illegible] when any materials will be ready f[illegible] dissemination. There are, however, [illegible] number of courses in various stage[illegible] of development. Information [illegible] of commercially available materials [illegible]s been published and more [illegible] prepared for publication.

MSSD [illegible] BSCS's (Biological S[illegible] Curriculum Study's) two programs that we[illegible] developed for the mentally retarded - Me Now (Grant, 1975) and Me and My Environment. The third program in the series Me in the Future which BSCS is field testing now was developed with the participation of one of MSSD's science instructors. MSSD's experience with ESS (Elementary Science Study) materials and with BSCS's Invitations to Discovery is being prepared for publication.

MSSD has under development courses in Animals, Plant Study, Genetics, Human Biology, Chemistry I "Scientific Procedures", Chemistry II "Physical Properties", Chemistry III "Matter", Chemistry IV "Atomic Theory", Geology, Environmental Studies, Measurement, and Weather. Most of these courses have an "Instructional Package" (IP) format. An IP typically consists of written materials, books, films, equipment, and any other materials that may be needed to complete a lesson.

References

Crammatte, A.B. Deaf Persons in Professional Employment. Charles C. Thomas, Springfield, Ill., 1968.

Curtis, J.J. Educators of the Hearing Impaired Prioritize the Needs for Instructional Materials. American Annals of the Deaf, 1976; 121(5), 486-488.

Grant, W.D. Me Now and Me and My Environment: Science for the Exceptional Student. Science Education, 1975, 59(2), 249-254.

A Project to Determine the Feasibility of BSCS's Me Now for Hearing-Impaired Student. American Annals of the Deaf, 1975, 120(1), 63-69.

Lunde, A.S. and Bigman, S.K. Occupational Conditions Among the Deaf. Gallaudet College, Washington, D.C. 1959.

Office of Demographic Studies (ODS) Stanford Achievement Test, Special Edition for Hearing Impaired Students. Unpublished data.

Rosen, R.F., Roesch, I.H., Beasley, E.E., Higging, F.C. and Lloyd, E.B. Science Teacher Qualifications and Resources in Schools and Classes for the Hearing Impaired, United States, 1972-73: Data From a Survey of Science Teachers of the Hearing Impaired. Gallaudet College, Washington, D.C. 1975.

Schein, J.D. and Delk, M.T. The Deaf Population of the United States. National Association of the Deaf. Silver Spring, Md. 1974.

Summers, H.D., Rubin, F.S. and Rawlings, B.W. Selected Statistics on Deaf and Hearing Impaired Students. Pre College Programs, Gallaudet College 1977.

Tabular Summary of Schools and Classes in the United States, October 1, 1976. American Annals of the Deaf, 1977, 122(2), 138.

Trybus, R.J. and Karchmer, M.A. School Achievement Scores of Hearing Impaired Children: National Data on Achievement Status and Growth Patterns. American Annals of the Deaf, 1977, 122(2), 62-69.

A REPORT FROM THE NATIONAL DEMONSTRATION SCHOOL FOR THE HEARING IMPAIRED: SCIENCE CURRICULUM DEVELOPMENT

Daniel D. Burch

For the purpose of this presentation, Kendall Demonstration Elementary School's approach to curriculum development will be dealt with on a chronological basis. First, a brief history will be outlined of the present curricular project. Second, a philosophical basis will be presented and how it is manifested in our curricular work. Finally, the plan for future revision and curricular work will be summarized.

BACKGROUND

Kendall Demonstration Elementary School has had national demonstration status now for a little over six years. We received this status, and our budget, from the United States Congress. As such, we are charged to develop models for administration, management, budget, and instruction, and to disseminate these models throughout the country, and on an international basis.

Like so many other schools serving the hearing impaired, we are also in the process of curriculum development. Our process has been outlined to a five step process. Initially, outside consultants were given the task of developing eight curricular areas; mathematics, social studies, socio-emotional, functional, language, reading/writing, and science. (See Appendix I for prototype). The faculty used this prototype for one year.

The second step was begun in the summer of 1977. An in-house committee was chosen for each curricular area. For the purposes of this paper, only the science curriculum will be dealt with from now on. The science committee consisted of one departmental supervisor and one representative from each of our four departments; pre-school, primary, elementary, and middle school. During this session, the curriculum objectives were re-worked and organized into a checklist recording system. (see copy of curriculum; Appendix II). It was also at this time that a philosophy of science education was addressed.

PHILOSOPHY

It became apparent that to revise an existing prototype into a workable model for the teachers, that a cohesive philosophical approach had to be decided upon by the committee attempting the revision work. It was felt that, due to the nature of the handicapping condition of the population, the base for which the curriculum would be disseminated, and multiplicity of backgrounds within the committee, that an eclectic approach to learning theory should be decided upon.

Thus, the first step of the committee was to agree on the use of content/process approach in science instruction, basedheavily on an experiential,"hands-on" approach to teaching. To represent this feeling, first, the eight processes outlined by Science: A Process Approach II were adopted. These are:

TRANSPARENCY I

1. Observing: "using the senses to obtain information or data about object or events";
2. Using space/time relationships: "the description of spatial relationships and their change with time...";
3. Classifying: imposing "order on collections of objects or events";
4. Using numbers: the manipulation of measurements "to order objects, and to classify objects";
5. Measuring: quantification of observations using measuring instruments and carrying out calculations with these instruments, as well as choosing the appropriate instrument for measurement;
6. Communicating: the use of "oral and written words, diagrams, maps, graphs, mathematical equations, and various visual demonstration";
7. Predicting: "a specific forecast of what future observation will be"; and
8. Inferring: "using logic to draw conclusions from what we observe".

These eight processes are dealt with differently and receive different focus depending on which department in the school the science curriculum is used.

TRANSPARENCY II

It has been stated that these eight processes are used by children in the early grades as independent models. However, as the child's thinking processes mature, the child begins to integrate until he/she is using all the processes in an integrated manner to solve a given problem. SAPA II has outlin ve integrated processes. These are:

TRANSPARENCY III

1. The ability to control variables
2. Interpreting data
3. Formulating hypotheses
4. Defining operationally
5. Experimenting

Second, in our consideration of strategies of learning, came Robert Gagne'. Gagne' is a descendant of the Skinnerian School of thought. He has delineated four stages in the development of a scientifically aware adult. These are:

TRANSPARENCY IV

1. The competent learner - pre-school to grade 8 - this is the stage of acquiring a broad base of knowledges - at this stage the teacher

and the child are involved in the development of performance capabilities, or skills. These skills include number computation, spatial manipulative skills, observing, classifying, measuring, describing, inferring, and model conceptualization.

2. The student of knowledge - 9 through undergraduate - the learning of broad critical knowledges - controlled observation, classification, measurement, inference, and the formation of knowledge.
3. The scientific enquirer - graduate level to Ph.D. - this level includes speculation, the formation and testing of hypothesis, and the discipline of self-criticism - observing, classifying, describing, inferring, and conceptual invention.
4. The independent investigator - out of school - this is where the investigator begins new lines of investigation in a disciplined, responsible manner, with deliberate attention to what has gone before, but with a mind that is unhampered by tradition.

Therefore, according to Gagne' - we here are working only with the competent learner.

Gagne', besides his breakdown of strategies of the development of investigative thinking is also well known for his reliance on the Skinnerian objectifying, or quantifying, of behaviors leading to terminal behaviors. The influence of this man can be seen in the lists of behavioral objectives that appear in almost all new curricula on the market. The implications for the revision of the curriculum guide for this school is toward a more concise and precise way of stating desired behavioral outcomes on the part of the children, especially within the content objectives.

Third, Jerome Bruner has based his work on the hypothesis that "any subject can be taught effectively in some intellectually honest form to any child at any stage of development". His theory is based on Piaget's stages of cognitive development, which will be looked at in a few minutes. Bruner's major contribution to curriculum development has been the idea of the "spiriling curriculum".

The spiral approach, that of teaching each area of content at each level of instruction, and teaching the salient features based on the level of cognitive development can best be seen in Kendall's curriculum by looking at the science network.

TRANSPARENCY V

Each area of concern in science is to be dealt with at every level of instruction within the school. Once again, as far as curriculum revision, each area must be re-examined to make sure that the salient features are included, that extra material is deleted, and that each lower stage leads directly into the next higher level of instruction.

The learning theorist with the most impact on contemporary education is Jean Piaget. He has broken down cognitive development into four basic stages. These are:

TRANSPARENCY VI

1. Sensori-motor - birth to 18 months - this stage is a pre-verbal stage. It can be characterized by the "out of sight, out of mind" paradigm.
2. Pre-operational - 18 months to 7 or 8. Here, the child is beginning to organize his/her language and symbolic functioning. Logical thought

has not yet appeared. The child is incapable of multiple classification, has no conservation of matter skills, and learns by a trial and error method.

3. Concrete - 7 or 8 to 11 or 12. Here, we should see the emergence of elementary logical operations, the development of simple classification, conservation of number, substance, length, area, weight, and volume. Here also, reversible thinking develops. The child still, however, cannot isolate variables, making cause and effect relationships unclear.

4. Formal operational - 11 or 12 on. In this final stage, the child begins to develop hypothetical thought. Here also, is evident the combination of systems and the unification of operations into a structured whole. The child is finally capable of controlled experimentation, the isolation of relevant variables, and reversible thinking.

Piaget has been, and will continue to be, manifest in our curriculum by the arrangement of content objectives; for their suitability for the age group for which they are intended.

CURRICULUM FUTURE:

The next section of this presentation will outline the future of the KDES science curriculum in terms of objectives, activities, evaluation, and teacher preparation.

In the summer of '78', a science committee will again be designated to revise the existing science curriculum (i.e., our list of objectives). Close attention will be paid to the appropriateness of the objectives to the level (again, incorporating the research of Piaget), to a clearer statement of quantifiable behaviors (again according to accepted procedures as defined by Gagne'), and to a blend of content and process objectives on a spiraling continuum (as outlined by SAPA II and Bruner).

Along with the revision, the committee must keep in mind the intended use of the curriculum. The guide must be general enough to be used cross culturally (i.e., throughout the United States and on an international basis), as well as specific enough to be used with our own population. It has been proposed that the science committee be composed of personnel currently using the curriculum guide and outside professionals involved in teacher preparation.

With this revision, teachers will be asked to begin contributing lesson plans, unit plans, and specific activities geared toward the mastery of the stated objectives. Activities and suggested materials will also be pulled from Space, Time, Energy, and Matter: An Elementary Science Program (S. T. E. M.), the Modular Activities Program in Science (M. A. P. S.), the Piaget Early Childhood Kit (Lavetelli), and Science K-13. These activities will be accumulated and collated with the objectives to serve as suggestions for teachers in the field.

As with any form of instruction, allowance must be made for some form of evaluation of student progress. This progress can, of course, be mapped out on the science networks. To do this, there needs to be some standard form of measurement; a standard instrument for evaluation. Our graphics artist and our materials developer, along with our science teachers, are currently involved in the development of pre-post - test materials that will eventually be packaged to go along with the curriculum dissemination.

Upon total completion of the pre-post - test package, the Model Secondary School for the Deaf, our neighbors at Gallaudet, will be contacted for the purposes of further field testing. MSSD is currently involved with identifying schools within the area that can be used to field test materials before their necessarily be lost. It has also been my experience that teachers are more satisfied with their programs if they can revise and update them as desired.

The computer has special attributes, which can not be matched by other means. One such attribute is that of patience. There is nothing more patient than a computer terminal waiting for a student response. It will just sit there humming until some response is made, and will repeat a question or answer or reponse or experience as long as any student could ever wish.

Another virtue the computer has is that of similar variety. The computer can generate almost an infinite number of examples for student practice. These problems would or could all be similar in style but differing in one small value, thus offering practice without exact repetition. Any of us would tire of this after 8 to 10 such examples but the computer will gladly serve up 50 of them if the student requests.

An interesting project has been developed in North Carolina. CAI with voice response for tutorial instruction and practice gives vocal feedback to blind students. Using appropriate tones the students are taught by the system the computer keyboard and their questions and answers are vocalized by a voice synthesizer. (3) The project uses a microcomputer whose major components are "off-the-shelf", that is, available on the general market and not developed specifically for that project. While the subject matter is data processing, I believe that Project VOCAB is a groundbreaker which should develop into a monumental beginning for teaching blind students.

An interesting and one of the most promising statements concerning CAI was made before a House subcommittee. It was that federally funded CAI projects in Los Nietros, California had reversed a 16 year decline in math achievement scores. (4) "Before computers, the district had tried to improve students' academic achievement by hiring more teachers, teachers' aides, and bringing in enough volunteers to have one adult for every seven students in the district. But after three years, student achievement had actually dropped slightly." 24 microcomputers with CAI reversed the trend and improved the scores by 2 years' growth on achievement scores and there was also improvement in other than math scores which were due to CAI.

A final example relating to the special advantages and to the flexibility of computer-assisted-instruction is from the American Annals for the Deaf.(5) and it concerns the teaching of poetry. To enhance the non-hearing persons' feeling for poetry "textured-words" are used to relate poetry visually. The texture animated presentation of language is used to alter the space-time presentation in which the concepts of the poem are delivered, similar to the way in which a poem is orally rendered. The words and phrases appear in special order and arrangement in a special rhythm to give the student a better feeling for the content of the poem than would the words by themselves offer.

It has been the purpose of this paper to indicate to the reader some of the ways that computer systems could be used in the teaching of physically handicapped students. It is my belief that by such use the quality of such education would be higher than can be obtained in other ways and the cost could be substantially lower. It is not <u>the answer</u> to our problems in teaching. It is an answer to some very tough questions concerning the education of our future citizens who need special help.

BIBLIOGRAPHY

1. Hewlett-Packard Educational Programs-Contributed Program

2. Huntington Computer Project, General Services Dept. 836 North Street, Tewksbury, MA 01876

3. The Wang Laboratories Programmer, March 1977, p. 18-21, "PROJECT VOCAB"

4. Education of the Handicapped, Nov. 9, 1977, p. 7, "COMPUTER-ASSISTED-INSTRUCTION HELPS LOW-ACHIEVERS, CONGRESS TOLD"

5. American Annals for the Deaf, Feb. 1976, p. 38-43 "COMPUTER-ANIMATED and TEXTURED PRESENTATION OF LANGUAGE FOR THE DEAF", by Arthur Layzer

6. Computers and the Learning Process in Higher Education
J.F. Rockart and M.S.S. Morton
McGraw Hill Book Co. 1975

7. The Computer and Education, Education Technology Publishing Co., 1973
Englewood Cliffs, NJ

S AND PHYSICALLY HANDICAPPED STUDENTS

"Project SCI-PHI: Science Career Information for the Physically Handicapped Individual"

"An Intervention Program for Occupational Stereotyping by Deaf Students"

"Geology as a Career for the Disabled"

"Attracting Severely Disabled High School Students to College Careers in Science"

(No Paper)

"Science Education and Careers: Personal Views from Wheelchair Level"

erson

PROJECT SCI-PHI: SCIENCE CAREER INFORMATION FOR THE PHYSICALLY HANDICAPPED INDIVIDUAL

Neal H. Berger

What can the physically handicapped do? Well that's like asking, "What can a 1,000 pound gorilla do?"... Anything he wants to! Handicapped people can and are already functioning successfully in numerous science careers that many people previously thought were impossible, or just for the non-handicapped. Blind electrical engineers, deaf biochemists and individuals like a research surgeon with no legs and opposing digits on his only hand, are successfully participating in science careers.

Many times, we as educators and counselors have played-down or discouraged the handicapped from entering the world of work in science. Rarely, have scientists discussed with me the encouragement that a science teacher, vocational rehabilitation counselor or school guidance counselor has given them. The Handicapped Scientists, with whom I have spoken throughout this country, have indicated that the greatest handicap that they have to overcome has been the attitudes of others, and not their own physical handicap. There are perhaps thousands of people with orthopedic, visual and hearing handicaps, with excellent abilities in Science, who are now working at jobs such as broom making. Many of these people might have provided a new technique or discovery to revolutionize our world.

Our objective in Thomasville, Georgia has been to provide
ful information on about 210 science-related careers which
ld be of value to anyone, handicapped or not. Quite inten-
nally, we have not said whether someone should or should not
sider a particular career. Rather, we have tried to design
eer guidance information which will not single out an indi-
ual simply because of his/her hancicap. It has been the judge-
t of many members of our national handicapped science advisory
rd, and consultants, to provide the right kind of information
that an individual with good decision-making skills, can de-
e for themselves.

The purpose of Project SCI-PHI is to provide an integrated
ence-related career guidance system which will encourage and
ist physically handicapped individuals to undertake science-
ated careers. The target population in this project includes
ior high students through adults, with orthopedic, visual and
ring handicaps. Project SCI-PHI is supported in part by a
ional Science Foundation grant under their Handicapped in
ence Program, 1977-78.

SCI-PHI, which is an acronym for Science Career Information
the Physcially Handicapped Individual, is a complete set of
eer guidance materials which are appropriately designed for
specific needs of the physically handicapped. The content,
mat and approach has been endorsed by the project's National
ence Advisory Board, which is composed of over 30 handicapped
entists, nationally known educators, and vocational rehabili-
ion experts from the Georgia Department of Human Resources.

Prior to developing the materials, a national telephone survey was conducted to determine the need for developing a science career guidance system for use by field and public school counselors, science teachers and rehabilitation specialists, who work with the physically handicapped. Almost without exception, these institutions, agencies, and individuals stated that such materials were non-existent and further, appropriate science-related career guidance materials could act as an indispensable resource from which many other guidance services and career decisions could evolve for the physically handicapped.

Following this assessment phase, we have contacted hundreds of handicapped and non-handicapped scientists throughout the country for assistance in this project. The response has been extraordinary! Many handicapped scientists have provided taped interviews and many other contacts by phone and letter have provided us with excellent input for the SCI-PHI Project.

Some of the products resulting from this input include: filmstrip/tapes, Braille career information, an audio library, and over 200 science career briefs in hard copy and microfiche formats. Each of these components will now be explained.

The first component we will examine is the filmstrip/tape series. Here interested students have a choice of viewing ten different filmstrips. Fifty people in science-related careers were interviewed and photographed on-the-job to assemble this particular program segment. Students are offered a basic job description, while simultaneously seeing and hearing or reading

depicted. In addition, the scientist offers
oncerning coping strategies, motivational fac-
ls about their career.

) pages of Braille in ten volumes offer the
users a chance to explore the 200+ science ca-
nes will provide complete job briefs covering
umber, (six and nine digit codes), a general
able working conditions, educational back-
unities for advancements, worker characteristic
look at wages. In addition, a tape with cop-
litional information for the visually handi-
Accompanying the volumes of Braille will be a
tte tapes which permits all users except the
same 200+ science careers.

l the use of these materials the printed copy
efs has been included. A typical career
r pages of information which is written on a
ing level, and has been printed in 18 point,
ch of these briefs contain the same informa-
the Braille and audio cassette materials.
be a handling problem in using the more
decided to also provide a set of microfiche
ers. By using microfiche, 1,000 pages of
reduced to 15, 4"x6" pieces of film which
l in a reader device. The microfiche is
copy briefs.

As a means of encouraging the handicapped into science careers we have also developed a series of T.V. and radio public service announcements. Two, one minute, 30, 20, and 10 second T.V. shots have been produced. These will feature actual handicapped scientists.

In closing, there are many intricate and interesting details that I would like to share with those interested in this project. Insights into the surveys, interviews with the scientists, and even the process of compiling all this information on such a tight budget and time-line, can be interesting. However, this will have to be for another time.

Mistakes have been made, but to be honest to you and myself, we have assembled a wealth of data that has never been collected before. In a sense we have only scratched the surface of science career information for the handicapped. We hope that by pilot field testing these materials this Spring, we can provide a variety of ways in which these materials can be effectively used and improved. We hope to locate additional funding sources to provide for additional field-testing, product revision, updating and the addition of more valuable features.

AN INTERVENTION PROGRAM FOR OCCUPATIONAL STEREOTYPING BY DEAF STUDENTS

Judy Egelston Dodd

The handicapped face many barriers to successful career development in science and technology. The most notable include the lack of role models, deprivation of science content in their schooling, and discrimination based on negative societal expectations and personal aspirations. Deaf students must face all these and overcome the additional burden of a communication barrier.

There is abundant evidence of highly consensual norms and perceptions regarding males and females. The stereotypes attributed to men and boys are perceived to be more socially desirable and more advantageous to a person seeking a niche in the world-of-work of a scientific environment.

Many occupations in the United States have traditionally been divided according to sex, "men's work" versus "women's work." Although men and women have recently entered fields where fewer than thirty percent of the jobs were held by someone of their respective sex, many technical and scientific occupations still remain dominated by one sex. Since the passage of Executive Order 11246 in 1965, very few occupations can be legally restricted by sex. However, if an individual feels that a particular job is inappropriate for his or her sex, that occupation is as good as closed, because he or she will not aspire to that job as a personally-potential occupation.

Deafness, like sex, represents a characteristic regarded by society as a handicap for holding certain jobs. Hearing-impaired students suffer not only the same curriculum deprivations that perpetuate stereotyping of occupations as their hearing peers, but they have also not had career education exposures which have been planned and implemented with their particular type of handicap in mind (Munson and Egelston, 1974). Junior high school-aged deaf adolescents are reportedly three times more likely to stereotype occupations by sex than are their hearing peers (Egelston and Kovolchuk, 1976).

Not only are deaf workers found in disproportionately large numbers among low paying, low status, dead-end jobs, but the majority of deaf students at both Gallaudet College and National Technical Institute for the Deaf are enrolled in programs traditionally appropriate for their sexual identity (Cook and Rossett, 1975). Both distributions show the effect of self-selection and aspiration based on traditional stereotyped notions of what deaf men or deaf women can do. Deaf adolescent women reportedly have a more traditional view of their sex role as manifested in vocational choices than do their hearing peers.

Freshman at National Technical Institute for the Deaf rated jobs 1) as appropriate for males only, females only, or both; and 2) as appropriate for only hearing workers, only deaf workers, or both. Correlation analyses showed males tended to stereotype jobs by sex more than females, as expected since most of the technological majors represent pioneer choices for women. The strongest correlation (p .001) revealed that students who stereotyped jobs by sex also regarded deafness as a limiting handicap (Egelston-Dodd, 1977).

Intervention in these beliefs through science career planning seminars targeted at secondary school age deaf students could liberate their personnel aspirations from the stereotypes of sex and deafness. A program for educators of the deaf which serves to raise their awareness of the detrimental effects of such channeling has its precedent in hearing schools where a deliberate attempt to overturn societal values and eradicate racism and sexism has resulted in response to Title IX of the Education Amendments of 1972. Such a plan in schools or vocational programs for the deaf, where stereotyping is even more rigid, has never been undertaken. It is past due.

For deaf people the effect of societal pressure to fit the doubly stereotyped occupational roles mandated by their sex and their hearing impairment is abundantly evident. The channeling of deaf males into machine or printing trades and of deaf females into keypunch operation or domestic duties is one result of the failure of schools and rehabilitative social and vocational services for the deaf to counteract the effects of this stereotyping.

The need for materials and strategies for a science career education effort which counteracts sexism and other discriminatory societal influences has been documented by Dr. Joanne Stolte, director of the NSF project, Science Career Development for the Deaf (1977). Deaf scientists, particularly females, are not readily available as role models. Schooling for the deaf, even through secondary level, emphasizes language development to the exclusion of science content. The business community views with pessimism the difficulty, inconvenience and expense of communicating through an interpreter, learning manual communication and installation of teletype equipment to serve as telephone substitutes for potential deaf employees. The infeasibility and risk of a hearing handicapped person working with science equipment has been cited as rationale for the low participation of the deaf in careers in science and technology. The Philadelphia-based project proposes to provide successful role models, enhanced science content and positive expectations for career development in science in the hopes of stimulating scientific aspirations in secondary deaf students.

In light of such current development efforts, the design of a paradigm or philosophical context for the production of materials and strategies seems timely.

ntitled Research and Utilization of Educational Media Deaf, held in Nebraska in 1973, which focused in career novative career and vocational learning activities, it hown that materials that work well with hearing students needs of deaf students. Although they can be modified ed, etc.) they do not offer the exposures and expe- e essential in the education of deaf students. Rarely cient detail are the kinds of work problems and atti- workers encounter in the safety regulations, communica- relations aspects of a job.

ton (1974) have reported a career education model which tly developed for intermediate and secondary level deaf REED model was explored as part of an action research project in three New York State schools for the deaf. resulted in the preparation of a program for meeting eer education needs of deaf students.

l general trends in the American job market which will lth structured and frequent career education experiences s and bring "pay off" in eventual human marketability. tional trends that affect the employment of American automation and the replacement of low-level, routine quiring a high level of education and training, 2) tech- pments which require sophisticated knowledge and skills, realm of sub-professionals who perform the less complex rried out by doctors, nurses, teachers, counselors and

nt developments represent changes which impact fortui- e career development for the deaf. These positive ude 1) the tremendous success achieved by the National te for the Deaf in providing skills and opportunities l fields which were previously closed to the deaf, tanding of the deaf and their problems which has in- ntly during the past few years due to television, anti- egislation aimed at all minorities, and a growing na- r making all handicapped fully participating members of , and 3) career education which is rapidly becoming a of the total educational process in our schools.

se developments to augment the science career potential f learners, there must be a firm grasp of the theoreti- derpinning the career education movement. Egelston-Dodd ized the field as revolving around four positions. On l continuum the first concept represents only the eco- reer education. Another position widely covered in the professional literature is the specific training required in the preparation for a job or some paid employment. The third conceptualization which is most compatible with an intervention program such as the one described in this paper, includes employability and occupational education but is not limited to the economic or work role. This position defines career education as a comprehensive self-development and career decision-making process approach. This concept evolves into position four, a life-time career development approach with the intent being an eventual provision for a total life-span tied to career development.

As we begin to view science career development in its broader, more encompassing dimensions, we are better able to accept it as vital for human maturation and intellectual development. Recent research on self esteem and self concept has suggested that children who have a positive self concept tend to achieve more. In the science education of deaf learners we should be able to keep in perspective the disability caused by hearing impairment and highlight the identification and development of each student's individual attributes and skills.

A science career education program can be infused into the existing secondary curriculum offerings using these four basic channels: 1) the self, 2) the conceptual, 3) the informational, and 4) the experiential (Munson, 1971). Briefly each of these can be differentiated as follows: Self exposures focus on the individual and his or her "being" and deal with the many component concepts of self that comprise the total self concept of the individual. Activities can be designed to provide deaf students with opportunities to explore their values, attitudes, abilities, aspirations, personally held stereotypes, and personal traits from the perspectives of their sex and the limits of their hearing handicap. Science classes represent an appropriate medium for teaching the analytic skills involved in such self evaluation (R. Egelston and J. Egelston, 1973).

Conceptual exposures contribute to the individual's general understanding of the nature of work, work functions and work roles, and also emphasize the development of attitudes and understandings that permit an individual to think abstractly about the role of work in their lives. Language serves an important function in conceptual learning. Deaf students need to understand the special vocabulary associated with the work function concepts. This vocabulary can be infused into instructional content units where the terms would be appropriately studied as part of the regular academic curriculum. Such work function terminology as negotiating, computing, and analyzing are already a part of typical science classroom experiences. Conceptualization of the tasks involved in a work situation may occur with repeated exposures and teacher guidance.

Informational exposures provide for input of a factual nature and deal basically with expanding students' knowledge abour specific science-related jobs and career opportunities in the world of technical and scientific occupations. The informational channel must provide the very special information about job duties, work requirements and qualifications so that an individual has the needed knowledge for problem-solving and decision-making activities associated with his or her career development. Students cannot be exposed to all the career information which they may eventually need. They [illegible] learn how to locate information about the general duties of a job, typical work situations, the physical demands and conditions of an occupation, the personal qualifications and preparation requirements. Because the informational channel has a much stronger tradition in guidance and education in general, this material must be examined carefully for the stereotypes which could limit full career development in science. The failure to illustrate a mixture of males and females or handicapped and non-handicapped workers in the literature depicting a scientific career is a potent message to the reader which will impact on career decision-making. Teacher intervention involves bringing live role models of deaf workers of both sexes to the science classroom to serve as a direct source of career information, when they are available. If not, use of media which show an appropriate mixture of workers will help break the stereotypes.

Experiential exposures permit individuals to evaluate their feelings toward and skills in specific science-related jobs or work role relationships. This potent channel is rarely tapped in the typical science education program. Labor legislation has increasingly excluded the young from these real exposures, and economic conditions have limited part-time and summer work opportunities in any field. Although actual work provides real experience, life-like experiences of a simulated nature can be planned. Other strategies which can be employed to provide deaf students with experience in the actual dynamics of work include field trips to work sites, classroom and laboratory work, and homework assignments. In school deaf learners engage in work functions associated with data, people, and things. Schoolwork demands are real, and an individual's experience with these tasks, with the demands and pressures of completing these tasks and with the nature of the conditions in which the tasks must be accomplished, can be converted into meaningful experiential learning. Science teacher sensitivity to stereotypes regarding what deaf males and deaf females "can't" or "shouldn't" do must be displayed in the assignment of tasks so that engineering and physical science work doesn't go exclusively to the boys and record keeping or lab technician chores wind up assigned to the girls.

Women and especially deaf women (Connor and Rosenstein, 1963), are very aware of and sensitive to societal expectations. Therefore, another application demanded of any endeavor to enhance science career education is a model which works to undermine the stereotyping of jobs, interests and abilities according to rigid ideas of the limits imposed by sex or by possession of a handicap. Adherence to the guidelines established by the NEA's recommendation for the elimination of sexism in curriculum materials is mandatory for the content, illustrations, language and philosophical base of any such program.

Finally, all of these changes depend on the positive and unlimiting attitudes of educators of the deaf toward sex roles and the handicap of deafness. Strategies for freeing educators of culturally derived biases have been developed for the hearing population through HEW sponsored programs. Infusing such strategies into the pre-service and in-service training of educators of the deaf can raise their awareness of the oppressive effects of stereotyping and demonstrate positive models of teaching behavior, counseling techniques and school policies which can intervene in sex-role stereotyping.

References

Rosenstein. "Vocational Status and Adjustment of Deaf
a Review, December, 65 (10), 1963, 585-91.

ossett. "The Sex role attitudes of deaf adolescent
eir implications for vocational choice." American
e Deaf. 1975, 120, 341-345.

L. Kovolchuk. "Stereotyping of Occupations and Occupa-
ations of Junior High Aged Students Using Parental
d Occupation, Sex, and Deafness as Correlates."
ted at American Personnel and Guidance Association
ng, Chicago, Ill., April, 1976.

J. Egelston. "Self-Evaluation and Performance on
sts," Science Education, 1973, 57 (4), 525-531.

"A Philosophy and Paradigm for a Career Education
Deaf Learners," Journal of Career Education, III (4),

"Occupational Stereotyping," American Annals of the
122 (5) 489-491.

radigm for Vocational Learning Maturation." Univer-
ester, Unpublished paper. 1971.

Egelston. Career Development in the Education of the
l CREED Report), University of Rochester, October, 1974.

GEOLOGY AS A CAREER FOR THE DISABLED

Carol Faul

Of all the physical and biological sciences, geology as a course of study is among the most amenable to the orthopedically disabled student. In most areas of geological study, modifications can easily be made in the laboratory. Abundant employment opportunities exist in the academic world, in state and federal government agencies, and in private industry. With the current emphasis on energy sources and the continued concern about the environment, the field of geology is strong in employment opportunities now and will probably be even stronger in the future. This paper explores the problems and solutions for the orthopedically disabled geology student and the professional geologist. Some reference will be made to the visually impaired student.

EDUCATION

Both classroom and laboratory work are, in almost all instances, very adaptable to the individual needs of the disabled student. Classroom work in geology usually consists of lectures and rarely, demonstrations. The student with ambulatory difficulties should have no special problems. Those with manual or visual disabilities can employ the special aids such as typewriters or tape recorders used in other lecture courses.

Unlike chemistry, physics, and biology, the academic content of the laboratory work is of a nature that furniture, equipment, and techniques can often be modified for the maximum efficiency of the individual student, disabled or not. In the geology laboratory, tables are usually normal sitting height. Most mineral, fossil, and rock specimens used in elementary courses are "hand specimens", easily handled during study. Identification echniques for minerals include crystal form, color, handness tests, plus ther tests using simple portable equipment. Since many techniques are ommonly employed, the manually or visually impaired student might choose nose techniques be can perform most easily. Fossil identification is often isual or may be tactile. Auxiliary techniques may include making thin ection slides or separating fossils from their matrix. The student with nanual or visual disabilities may prefer to concentrate study on fossil groups hat do not require special physical techniques. The student using a wheelchair hould encounter no problems except perhaps reaching the sink. I have aught paleontology laboratory without any physical barriers hindering me lthough the laboratory was designed for a non-disabled instructor.

Geological, topographic, and other maps are an integral part of geological raining. They are, of course, easily movable to a convenient study height. For the visually disabled elementary geology student, excellent molded relief maps are available from supply houses. Equipment used in geology teaching and research is often portable. For advanced students, petrographic microscopes are easily moved to a convenient height, sedimentology sieving equipment is mostly portable, and so on. Of course some equipment, because of its size, rigidity of construction, or by virtue of its function, cannot be moved. Examples would be X-ray diffractometers and mass spectrometers. Since this sort of specialized equipment is seldom used by undergraduates, problems of their use would almost never arise. For a graduate student needing to use equipment with limited accessibility, machines can almost always be modified at little cost. For example, the control panels on a mass spectrometer can be lowered or the control knobs modified by a little thoughtful engineering. In fact, any disabled student who chooses to work with complex equipment would probably welcome the opportunity to assist in modifying the "tools of the trade" as part of his education.

Field work is an integral part of the study of geology. Even the non-majoring geology student must become acquainted with geological formations and structures, geomorphology, and fossil, mineral, and rock specimens observed in place. Every student in geology wants to be exposed to geology outside the classroom and laboratory; it is a fundamental reason why many students take a geology course. Fortunately, our road-building penchant can often serve to provide accessible rock outcrops to disabled students, including those in wheelchairs. On heavily traveled roads, pre-trip planning should include contacting the highway police for permission to stop and collect. A police escort can sometimes be arranged for safety. For less accessible localities, most geology departments own a rugged field vehicle to carry equipment and the collected specimens. The disabled student could ride in this vehicle and since much geology field work is a team effort, the student could do his share of the work right from the vehicle. His work could include observations on structure or bedding, interpreting maps, and making field identifications.

Some athletic specialized activities such as oceanography and antarctic geology would likely not be practical for a disabled student. Anyhow, the number of students chosen for such endeavors are few and there are many more geologists back in the warm dry laboratories working on deep-sea cores or Antarctic fossils than went out to collect them.

CAREER OPPORTUNITIES

The field of geology and the employment opportunities for geologists are expanding. Employment is available in teaching, research, museum work, private industry, and government regulatory, advisory, and exploratory organizations. Geology is now taught extensively from junior high school on. Many general science teachers may have a background in geology. Most college instructors combine teaching and research. The academic researcher often has the bonus of students to do his hill climbing and collecting for him. Museums can be excellent places of employment for the imaginative disabled geologist. Answering phone inquiries, identifying specimens brought in by the public, designing exhibits, and maintaining and adding to the collections are a few of the museum activities easily adaptable to the disabled geologist.

Private industry employs about one-half of all geologists, with petroleum companies the largest employer. Although surveying and geophysical prospecting is an integral part of the industry, micropaleontological, geochemical, and geophysical studies are usually done in comfortable laboratories. Mining companies are even more field oriented but they too maintain well equipped laboratories with numerous opportunities for employment of the disabled scientist. Public relations jobs for the person with geology training are increasing in private industry.

There are between 2000 and 3000 consulting geologists in the United States. The able and experienced disabled geologist might become a consultant, especially in conjunction with other employment. For example, the college professor might spend summers advising local governments on environmental planning, soil studies, highway planning, and interpreting aerial photographs.

Federal and state governments employ about one-fifth of all earth scientists, with the United States Geological Survey employing over 1500. Other federal agencies with geologists on their staffs include the Bureau of Mines, the National Park Service, the Department of Agriculture, the National Oceanographic and Atmospheric Administration, and N.A.S.A. Many government geologists choose to do a combination of field and laboratory work. Often they may spend a few months as part of a team studying or collecting in the field and then the remainder of the year in the laboratory studying the material collected, constructing maps, writing reports, etc. The disabled scientist might wish to emphasize the laboratory aspects or specialize in technical writing, editing, or library research. After all, not every government geologist collects his own samples - compare the ratio of those who collect moon samples to those who study them in the laboratory!

To summarize, the disabled student should find the field of geology one very adaptable to his needs. Little equipment cannot be made accessible to the ambulatory or manually disabled student. The visually disabled student will find many areas of geology feasible with the aid of existing regular teaching aids. Geologists tend to be inventive in their equipment and in any teaching situation there will likely be eager volunteers to adapt existing equipment. The image of geology as an athletic male-dominated field becomes more and more obsolete in the emerging emphasis on laboratory studies, computer geology, and regulatory and advisory services. Geology is truly an equal opportunity science.

Bibliography

Anonymous, Geology: science and profession, American Geological Institute, 1976.

Richard, Benjamin H. and Harold. W. Sundelius, Teaching introductory geology to a blind person, Journal of Geological Education, vol. XV, no. 4, p.152-153, 1967.

ATTRACTING SEVERELY DISABLED HIGH SCHOOL STUDENTS TO COLLEGE CAREERS IN SCIENCE

Heidi Fawber, Harry N. Ash, Howard T. Blane, Debra Boots, Margaret A. DeMichele, G. Edward Denslow, Richard E. Desmond, Linda E. Hewitt, Debbi Swazuk

The purpose of this paper is to report progress to date of a project based on the notion that perceived opportunity affects educational and occupational attainment. The project is designed to test a global method of influencing perceived opportunity structure among severely disabled high school seniors who show academic ability to further their education. This global method has several aspects:

1. We encourage students to apply for admission to college and offer them assistance in the application process.
2. We invite them to the Pitt campus for a week-end during which they meet and talk with college students, both handicapped and nonhandicapped, and faculty representatives to gain an impression of college life and how it can accommodate handicapped students.
3. During the week-end visit, students also meet and talk with severely disabled career models - successful administrators, doctors, engineers, and so on.
4. We provide academic and career counseling based on students' aptitudes and interests in the context of a voluntary, continuing relationship.
5. We reduce social and physical barriers against mobility and communication and attempt to create an atmosphere which encourages the freest expression of personal abilities and talents.

The project is being conducted within an evaluation framework that will allow us to draw inferences about the effectiveness of the method being used. Specifically, we have systematically selected severely disabled high school seniors who are receiving services from the state Bureau of Vocational Rehabilitation (BVR) and who have an average or higher I.Q., good high school grades,

*The preparation of this paper was supported in part by a grant from the National Science Foundation.

SAT scores above 750, and/or rank in the upper third of their class. We have a complex definition of severe disability; simply stated, it refers to impairments from any cause of hearing, sight, skeletal structure, or musculature which affect physical mobility, affect ability to manipulate objects, and/or interfere with communication of information. Selected students were randomly assigned to either a treatment or nontreatment group. Both groups are to be assessed before and after treatment on measures of perceived opportunity, vocational interests, and work values. In addition, we are obtaining relevant social background information and outcome data regarding college admission and enrollment. We are predicting that after one year, treated students will show greater increases in perceived opportunity measures than untreated students and that more treated students will be enrolled in college than untreated students. Information collected in subsequent years will be oriented toward choice of science majors and science careers.

With this brief description of the project in mind, we want to report today concerning early findings in three areas: subject selection, treatment, and development of measures. The areas of subject selection and treatment, in particular, have implications that go beyond our project and relate to recruitment of handicapped persons into science fields generally.

Our original plan was to obtain computer listings of all high school student BVR clients and to screen the lists for students who met our disability criteria. We then intended to obtain information about academic ability from the client's BVR counselor or school guidance counselor. From the resulting list, we would randomly assign clients to treatment or no-treatment conditions, and contact them accordingly. While we continued to rely on this procedure, it proved to be sufficiently cumbersome and problematic that we developed other procedures to identify severely handicapped students.

Mention of some of the difficulties we have run into may serve as a cautionary tale for others who need to systematically sample populations of severely handicapped persons. The problems were threefold and involved (1) the quality of the computerized data base, (2) discrepancy between our definition of severe disability and that based on federal standards used by BVR, and (3) adherence to rigorous but necessary confidentiality procedures.

Data Base. Sixteen district offices report client data to a central office computer. Seniors in high school usually don't begin to apply for BVR aid until late fall or winter of the senior year. Allowing for normal delay in getting this information coded meant that information about many seniors was not available in time for us to screen computer lists, identify clients appropriate for the program, obtain confidentiality clearance, and get the client into our program so that we could be fully of use to him. Further complications include individual variations among offices in the manner in which data are coded. For example, one office only infrequently used the code for high school students, preferring to code most high school clients as intakes. Another office submitted client data periodically rather than continuously, so that codes were often out-of-date. And so on.

Definitions of Severe Disability. Disability codes used by states are based on Federal definitions developed by the Rehabilitation Services Administration of HEW. While we had few problems with codes for visual or auditory handicaps, codes for orthopedic and other conditions provided little information about the extent of functional impairment. In order to make clear-cut statements in this regard, we found it necessary to contact district offices and individual counselors. This placed another time burden on subject selection. A separate code for severe disability used by BVR was defined more broadly than our definition, but did prove useful when clients with mental retardation and other mental/social handicaps were screened out.

Confidentiality Procedures. During the entire process of subject selection, we dealt only with client I.D. numbers in order to preserve confidentiality. Once a client was selected for the project, we submitted his number to the central office. From there, letters describing the program and inviting the client to participate in it were sent to the client and to the client's parents; these letters requested parents and client to sign a form authorizing BVR to give us the client's name and address and to share information in the client's folder. Only after the signed release form was returned to the central office did we know who the client was. This completely necessary procedure proved to be cumbersome, time-consuming, and subject to communicational error (in the version of this paper to be presented at the April meetings, data not now available about the proportion of acceptances by clients will be provided). Further, the necessity to preserve confidentiality prevented us from obtaining information about intellectual ability from schools when this was not available in a client's BVR file. This placed additional burdens on BVR counselors to obtain this needed bit of information.

As some of these difficulties became apparent to us, we began to explore other means of recruiting students to the project. We had already been in contact with the model school at Gallaudet College, and we stepped up this effort. In addition, we sent letters to public, parochial, and private secondary schools in the greater Pittsburgh area and to large communities in Western Pennsylvania. These letters explained our program and indicated how school counselors, students, or students' parents could contact us directly. While this was a less systematic way of proceeding, it short circuited the selection process involving BVR client lists (in the April presentation, we will provide data on the success of this effort).

These observations should not be taken to signify that State BVR's represent a poor means for recruiting promising youngsters to science careers. To the contrary, BVR's clearly deal with the largest number of handicapped students. If recruiting efforts were accommodated within State BVR's, many of the problems of accessibility of records and confidentiality procedures would be automatically solved.

One other observation: on the basis of our experience so far, it is probably better to begin the process of facilitating transition from high school to college in the latter part of the junior year instead of during the senior year. This allows time to take medical, social, ability and interest factors into account in choosing the institution most suited to the individual student.

Treatment

Our progress to date on program development has, for the most part, been very encouraging. University receptivity to severely disabled students in science has been mostly favorable, and there are existing services on campus that dovetail neatly with aspects of our program. The University has an office for handicapped students which is run by a blind staff person; this office serves as a fulcrum for advocacy of social and physical changes in the University to facilitate education for disabled students. Further, we have a BVR counselor on site at the University who is responsible for BVR clients enrolled here; she works out of our program offices.

Administrative support has been consistently present. For example, the Assistant Dean of Alumini Affairs, a long-time advocate for the handicapped, represented the administration during the on-campus visit of prospective students.

Many key individuals on science faculties also support the program. An astrophysicist is developing a summer program which includes a lab program for high school students as a transition to college. She is desirous of including disabled students and making modifications in equipment or devising organizational means to provide the highest level of training. On the other side of the ledger are faculty members who believe that scientific work, particularly as it involves laboratory manipulation, is not possible for students who are blind or confined to a wheelchair. They view deaf students as more able to master lab procedures but unable to grasp material presented in lectures. However, none would attempt to keep a student from registering for one of their courses, although they would not be likely to make accommodations for disabled students in their classes.

Our attempts to recruit successful career models proved to be extremely fruitful. There are a number of highly successful administrators, engineers, physicians and others who graphically portray the rewards to be gained by the severely handicapped person and the problems he or she faces in attaining educational and career goals. They are living proof that the opportunity structure is more open than many disabled persons have been led to believe.

Our experience thus far suggests that universities are generally receptive to severely disabled students and are prepared to make modifications in the social and physical environment that make educational opportunities as open and accessible to disabled as to nondisabled students. The matter appears to be largely one of education. Everyone sees the need for curb ramps and related mobility facilitators. But the need for interpreters, audio texts, Braille texts, appropriate examination forms, and other communication innovations is often less clear - not necessarily because of prejudice, but because of lack of knowledge about the implications of different handicapping conditions.

Development of Measures

We are measuring vocational interests and work values with standardized instruments of known reliability and validity. The Strong-Campbell Interest Inventory (Campbell, 1977) measures vocational interests, and the Work Values Inventory (Super, 1968) measures work values. Because of previous work on these tests, pilot studies were not necessary.

Our measures of perceived opportunity are based on work by Jessor and associates (Jessor, Graves, Hanson, and Jessor, 1968) and include three instruments: a personal values questionnaire, an expectations questionnaire, and a life chances inventory. The first two focus on relatively immediate goals in the peer group and in the school situation, whereas the life chances inventory is designed to tap more distant goals and values. While some psychometric work was done in the early 1960's on concurrent validity and internal consistency of the values and expectations questionnaires, the results are now outdated; further, the test-retest reliability characteristics of the questionnaires are unknown. As for the life chances inventory, we have revised and lengthened the original version of it, so it is in essence a new measuring device.

In order to assess the internal consistency, time reliability, and concurrent validity of these instruments, we administered them, along with some questions inquiring about social background information, on two separate occasions two weeks apart to a sample of 47 female nondisabled high school juniors.

The findings for the girls indicate that internal consistency as measured by coefficient alpha is acceptable for all three scales, ranging from .84 to .96. Test-retest reliabilities were .80 and .93 for the personal values and expectations measures, respectively, and .75 for the life chances inventory. While the latter figure is on the low side, it is nevertheless acceptable, considering the fact that this scale consists of only 10 items and is based on 47 observations.

Concurrent validity coefficients for personal values were in the expected direction when self-reported scholastic achievement (grades) was the criterion and, though they were not high, ranging from .25 to .57, all were statistically significant. When family socioeconomic status (SES) was the criterion, there were no significant correlations, although most were in the expected direction. The life changes inventory showed no significant relationship to either grades or SES, although correlations again were in the predicted direction. The findings concerning the validity of the instruments were not as strong as we would wish, but are nevertheless generally in the predicted direction (we plan to test a group of high school boys and will present these data if they are available in time for the meeting).

In summary, we have presented the rationale, operations, and some findings to date concerning means for identifying intellectually promising severely handicapped adolescents and for helping them to achieve their vocational goals. As we continue to work with these students in their college careers, we will actively support and encourage those with scientific interests and science career objectives to obtain the education they require to realize these objectives.

References

Campbell, D. P. Manual for the SVIB - SCII Strong-Campbell Interest Inventory, Second Edition. Stanford, CA: Stanford University Press, 1977.

Jessor, R., Graves, T. D., Hanson, R. C., and Jessor, S. L. Society, Personality and Deviant Behavior. New York: Holt, Rinehart and Winston, 1968.

Super, D. E. Work Values Inventory. Boston: Houghton Mifflin, 1968.

SCIENCE EDUCATION AND CAREERS: PERSONAL VIEWS FROM WHEELCHAIR LEVEL

Barbara Jane Mendius

When I read that one of the objectives for this conference was to "develop recommendations for science education and careers in science for handicapped students," I was pleased, because having just been through the mill, I hoped that my practical experience could be useful to others. I acquired my entire formal education while in a wheelchair. Since sixth grade my major academic interest has been science; this culminated with a M.S. of Biology from the University of Illinois in October, 1977. From my multitude of experience I have distilled two generalizations which I feel applicable to most handicapped students. One generalization deals with science education, the other with science careers. I will elaborate on each in turn.

As a scientist I am open-minded about, but always questioning, information I encounter. What are the assumptions? How were the data collected? Does the conclusion follow from the data? Observing everyday phenomena, such as rainfall, I wonder, How fast do raindrops fall? What determines raindrop size? How do raindrops form? I begin inventing hypotheses and then design experiments to test those hypotheses. Control experiments are essential to any test to reduce the possibility of spurious conclusions. This approach to questions follows the standard scientific dogma outlined for me yearly since about fifth grade. The question remains as to how that standard scientific approach actually becomes incorporated into a person's thought patterns. Which experiences in a student's education help him to think scientifically? In considering my own education, I firmly believe that my laboratory experience was the most profound shaper of my scientific ability. Therefore, Generalization I states: the first major obstacle for the handicapped student of science is getting the hands-on laboratory experience so important to engender scientific expertise.

I feel lucky indeed as I recall the variety of lab work which I performed in school. I have thought carefully about the factors which contributed to my successful scientific education; it all comes down to people -- parents, administrators, teachers -- willing to cooperate in my behalf. Realizing the value of scholarship, my parents took an active interest in my education. Active, but not pushy. Beginning in fourth grade I attended the local public school. For class field trips Mom would drive one of the groups to the museum, or to the nature center -- for laboratories are not only found in schools. Dad went to all the parent's nights, talked with my teachers, and came home glowing about my progress. Impressed with my parents' interest and my ability, school administrators were wonderfully cooperative. For some of the administrators, I was their first and only handicapped student. One particularly memorable superintendent played musical classrooms with the three-story-no-elevator junior high school so that I could have those teachers who normally taught upstairs. Luckily, the science rooms were on the first floor -- transporting gas lines isn't quite as easy as transporting globes. Back then, junior high science was mostly teacher demonstrations, and although science fascinated me, I had not yet gotten my hands into it.

That all changed in high school. There, all of my parents' interest, and all of the administrators' cooperation would have been wasted were it not for enthusiastic science teachers who gave me the freedom to do as much as I could of what everyone else was doing. Sometimes it only meant putting a microscope or analytic balance on a low table. Sometimes it meant rearranging the greenhouse so I could get down the overgrown aisles. In one case it meant encouraging this shy student to enter the state science fair and helping me choose an appropriate experiment which I could carry out myself. My teachers were the ones who ultimately placed science in my reach. I can't stress enough that their encouraging attitudes kept the You Can't Ogre locked out of my mind.

But we worked together, so my stubbornness and preseverence deserves some credit also. Science had piqued my brain; I was determined to learn as much as I could, actually doing as much as I could. I realized that if I wanted to do the acid/base experiments I would have to show that I could carry solutions around in my lap without spilling. If I wanted to firepolish my own glassware I had to show I could use a bunsen burner 'th-out setting myself aflame! If I needed to move a microscope to a lower table I had to show that I could do that without smashing it to smithereens. I had to prove myself all along the way, but my teachers accepted my physical abilities and, although I often caught a watchful eye on me, they did not stifle my enthusiastic investigations.

In summary then, my major recommendation for science education is to involve the student in lab experiments. Visual, auditory, tactile, olfactory, and gustatory clues can elucidate scientific principles; ingenuity and perhaps some extra work are all that's required. Ideally, teachers could contact a central office which collected and distributed experimental designs suitable for students with various disabilities.

Based on their experiences up through secondary school, some handicapped students will terminate their scientific meanderings in high school; others will embark on a scientific career. For the latter group Generalization II suggests: the most difficult challange for handicapped students on science is to match one's mental capabilities and one's physical capabilities with a productive and satisfying career. Personal bias perhaps makes me single out this problem as the most crucial. I did acquire a good science education, but I have not yet totally succeeded in choosing a career which is both mentally satisfying and within my physical capabilities. I do feel that my personal experiences in science career seeking have several worthwhile take home lessons of value to all handicapped science students and those who counsel them.

In examining my entire science education, I note almost a complete lack of career counseling related to my physical abilities. By pursuing a science education I realized that I could become a science teacher, a doctor, or that wonderfully nebulous creature called a scientist. Specific other careers were fairly unknown to me. Knowing full well what a science teacher and a doctor had to put up with, I opted to become a scientist fully confident that when I became one I would know what my job was. I maintained that painfully naive view almost to the end of my undergraduate years. As a senior I dove into the on-campus interviewing process applying for those jobs for which my coursework qualified me, mostly lab assistant positions. As interview after interview ended with, "It's been nice talking with you -- we'll contact you if necessary," I realized I was going to be an unemployed biochemist (and moving back to the safe but suffocating home nest) if I didn't get my act together very soon. The point reached home that lab assistant jobs went to people who could reach all of the equipment and all of the chemicals, not to someone who could reach almost everything <u>if</u> the lab were modified. After some quick careful thinking about my employment problem, I chose to try hospital lab work, taking six additional months of training in cancer screening. My thinking paid off because, indeed, I had worked my way into a profession which valued intelligent, meticulous workers, and which had jobs located in hospitals (virtually always accessible). I was suddenly very employable; for two years that kept me going as the near fiasco at college graduation faded in my memory. The novelty of employment wore off though, and I realized whereas my job suited my physical capabilities perfectly, I was mentally very understimulated. I turned to graduate school, treated myself to a mental orgy, and earned a Masters degree. I'm now looking for that job which will use my mental and physical abilities to the fullest. I have more options with an advanced degree and I am more aware of what will constitute a satisfying job for me.

Certainly though, such a circuitous route to a career is not necessary or desirable; a few recommendations may help others follow a more direct course. The handicapped student who is serious about studying science should be exposed, as early as possible, to the variety of jobs which are available in the sciences. He should also be encouraged to think about what types of careers would be compatible with his particular handicap, or alternatively, how to overcome various physical problems which might arise in a less obviously compatible career. The AAAS Resource Group for the Project on the Handicapped in Science is ideal for providing career examples and role models for the handicapped student; I hope that pamphlets aimed at various age groups will be developed using the Resource Group as an information base. Such material could be distributed though the schools by superintendents, deans, teachers, and counselors. A little guidance at an early age can set the stage for continued mature planning throughout the student's education.

I also feel that the handicapped student must be encouraged to prize his mind and develop his mental abilities just as an athlete prizes and develops his body. The handicapped student's strongest asset in job competition is his mind; it is his responsibility to keep it sharp. In order to accomplish that the handicapped student should be cautioned to seek a career which will use those mental abilities fully. If an advanced degree is required for a desirable job, the student should prepare for those extra years. If a job loses its challange, he should change. The handicapped person must learn to never sell himself short -- unless he is willing to let everyone do it to him also. Choosing a career is a hard decision for everyone; for the handicapped student it can be especially frustrating and frightening. With some assistance in planning and some guidance in one's personal value, career choosing can be exciting.

Finally, let me emphasize that in this technological era science is a vital part of every child's education. Some young people, will choose to pursue scientific careers. Some of those young people will be physically handicapped. I ask parents, school administrators, and above all, the teachers to let those students do all that they are capable of doing, show them their responsibilities to themselves, and open their eyes to the spectrum of scientific careers which exist. Your reward will be their success.

SPECIAL PANEL: FILM AND SLIDES

Participants:

Doris E. Hadary	"Laboratory Science and Art for Blind and Deaf Children: A Mainstream Approach"
Dorothy Tombaugh	"Mainstreaming Visually Handicapped in Biology"

LABORATORY SCIENCE AND ART FOR BLIND AND DEAF CHILDREN:
A MAINSTREAM APPROACH

Doris E. Hadary

A program of "what can be done" - not only "what should be done"

(This paper is accompanied by films and slides showing the areas of teacher training, curriculum design, implementation, and scenes of social interaction in the classroom.)

Introduction

In partial response to the question of the present status of science for physically handicapped students, I offer a description of Project Seefee which was started six years ago at The American University funded by the William T. Grant Foundation. The program went through a process of development, starting in 1971 as a science teacher training program to which in 1972 was added curriculum design and research in adapting science materials for blind and disturbed children. Adapting science materials for the deaf was added in 1975, as well as a related art program. Mainstreaming this program began in 1976. It is presently a program of laboratory science and art used as a vehicle to advance education for blind and deaf children. The project is a small, mainstreamed, multidisciplinary program for handicapped children which combines the inextricable elements of teacher training with emphasis on content and communication, curriculum design and implementation. These are essential elements to the success of any program for the handicapped - and for all children. The interdependence of these elements, I am sure, is recognized by educators, however, it is neglected and exists as fragments of the whole which need pulling together.

The present project consists of a total population of 200 ordinary children of the Horace Mann Elementary School in Washington, D.C. Blind, deaf and disturbed pupils are bused into the school four afternoons a week from nearby school districts for mainstreamed laboratory science and art classes in grades Kindergarten to 6. The handicapped children work side by side with the ordinary elementary school children. (Film)

Science and Art Curriculum

The curriculum consists of adapted science experiments and related art experiences which are based on the major science curricula being used today in elementary schools nationally and internationally. (Slides)

As a result of my participation in the development of science programs for elementary schools, I have had the opportunity for many years to make contributions to and make comprehensive reviews of many of the major science curricula being used today in elementary schools, in schools for blind children, for deaf children, and disturbed children. It is from these programs with the cooperation of Dr. Herbert Thier of Projects SAVI and ASMB, and various faculties from schools for the deaf that I have adapted science and art experiences making Project Seefee a program appropriate to the needs of hearing impaired and visually impaired students. The hearing and sighted children receive reciprocal benefits from the experience - academically, socially and spiritually. (Slides - scenes in the classroom.)

We have designed, adapted, implemented, and tested approximately 150 science lessons with matching art lessons from the following:

Biological Sciences

organisms
life cycles
ecosystems

Physical Sciences

material objects
experimenting with common objects
gases

Interactions and Systems

"inventing" the interaction concept
evidence of interaction
"inventing" the systems concept
systems in the classroom
gathering evidence through various senses
exploring pulleys
comparing pulley systems
"inventing" interaction-at-a-distance
magnetic interaction
electric circuit puzzles

Subsystems and Variables

solutions and mixtures
objects that can close a circuit
separating a powdered mixture
"inventing" the subsystems concept
"inventing" the solutions concept - filtering crystals
separating mixtures
properties of freon and water
whirly bird variables - controlling variables

Energy Sources

temperatures of water and ice systems
"inventing" histograms
"inventing" energy sources and receivers
transferring energy

Experiments on these topics were developed for gifted youngsters enrolled in the Enrichment Science Laboratory at The American University:

energy transfer
water wheels
energy chain concept
Archimedes principle
heart sounds and pulse
properties of light: refraction, absorption, reflection
properties of sound: vibrations, frequency, pitch
effects of string tension
effects of change in length of string
the resonator
the bridge
media for carrying sound
periodic motion
propagation of sound waves
medium through which sound propagates
vibration of the gong
properties of air: weights and elasticity
structure of the ear as an organ
frequency limits of the ear
coupling the vibrating string to a resonating box
vibration from the string to the body of the violin
dampening the resonator
vibrating column of air as origin of musical tone
thermodynamics - experiments to measure directly the mechanical equivalent of heat

(Slides)

Teacher Training

Our training program addresses itself to the new image the elementary school teacher must take on in the "real world" of the educator of children today. The teacher must get an appreciation of science as a powerful tool of communication with children and among children, of science as a means for development of self-esteem, of science as a way of the child's relating, understanding, living in one's environment, of science as a means of compensating for a sensual lack, of science as a means of making a handicapped child feel "complete". The teacher must be sensitized to the different needs of the handicapped children in general, and as they relate to the learning of science through the experiential approach. To accomplish this goal the pre-service program for our future teachers is content-oriented.

(1) An interdisciplinary laboratory course enveloping chemistry, physics, and biology is the base of the training. The teacher must "live" the experience of the experiential approach, the scientific method of problem solving, to learn the vocabulary that allows understanding of scientific concepts, and, above all, experience the excitement of discovering and understanding the concepts of science - to be able to effectively communicate with the handicapped child through science.

It is absolutely essential that teacher training with emphasis on science content must go hand in hand with learning skills of communicating with the handicapped child through subject matter. In order for the teacher to be able to deal with problems of communication with the handicapped child he/she must be knowledgeable in the philosophy of and science content involved in the experiential laboratory approach. This is extremely important since our experience shows that the approach provides a successful means for dealing with problems of all levels of communication that almost all handicapped children have.

The program prepares teachers to guarantee the handicapped child improved science education which is essential as a foundation for upper level science education and career preparation.

The teacher learns to adapt laboratory materials (slides) in accordance with the sensory channel preference of each child. In our practicum he/she does so by actual experience with the child - always testing, revising, and adding better ways of communicating to all the children - being constantly aware of learning content, learning rates, and learning styles. (Slides) Our teachers learn Braille and sign language. (Slides)

(2) Our teachers take part in seminars once every three weeks with psychologists, specialists in working with blind, deaf, and disturbed children.

(3) Lessons in Braille, sign language (total communication), and Que speech are given once a week.

(4) Research teams work with research directors and graduate students in designing and making studies of evaluation of the program. (See references.)

(5) Practicum in teaching science to ordinary children.

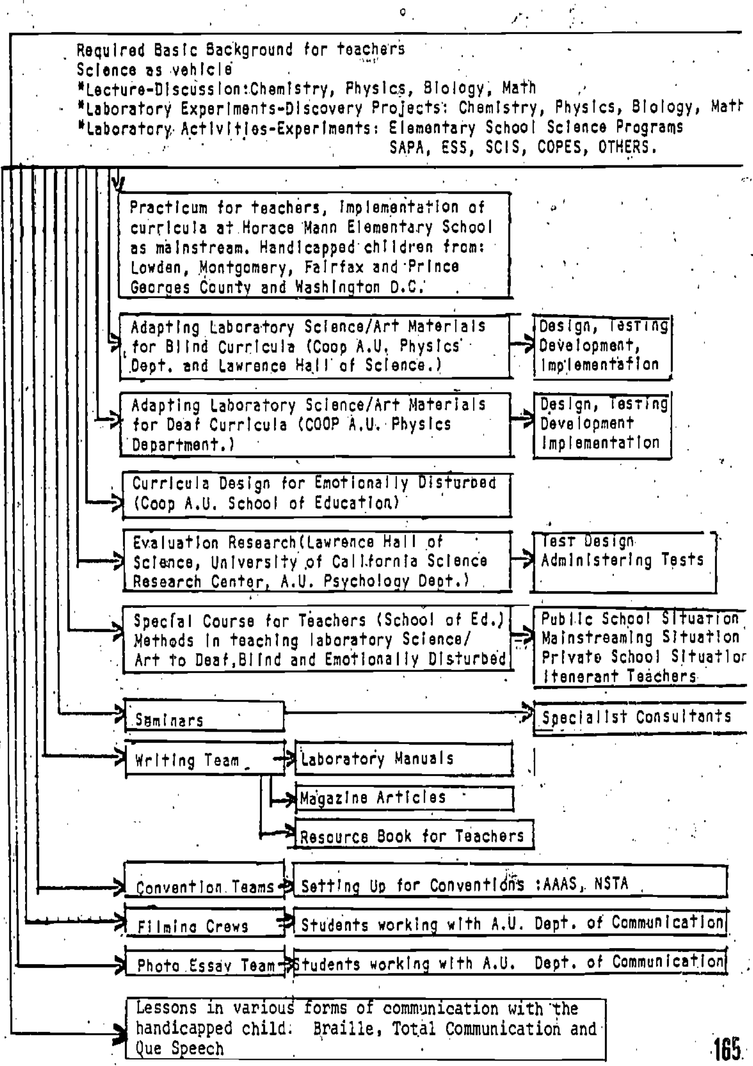
Practicum in teaching science to blind children.

Practicum in teaching science to deaf children.

(6) Laboratory sessions in performing elementary school science experiments. Learning use of adapted materials. Discussion and practice of teaching strategies.

The following page is a flow chart summary of the pre-service training curriculum.

ADVANCING EDUCATION FOR THE BLIND, DEAF, AND EMOTIONALLY DISTURBED, THROUGH LABORATORY SCIENCE/ART-ORIENTED PROGRAMS



Research

I should like to briefly mention some results of the most recent research pertinent to mainstreaming deaf children in science classes in our program.

Three forms of evidence suggest the advantages of the mainstream situation. (1) Results of cognitive tests show no difference in gains between resource students and mainstream students. (2) Results of observation of the performance of resource and mainstream students indicate that in both situations students can engage in interactive learning experiences, although in the resource setting there are more opportunities for discussion and reporting of results verbally, whereas in the mainstream situation there are more opportunities for working with apparatus. (3) Results of the questionnaires administered to non-handicapped students in a mainstream situation indicate that students, in general, were very favorable about the presence of the handicapped children in their classes and, in fact, very frequently pointed out the advantages of having the handicapped children for their own educational benefit. In addition, only the youngest students were concerned about the presence of handicapped children, and their concern appeared to stem more from their lack of familiarity with handicapped children than from any specific aspect of the instructional program. Thus, it is likely that the concerns expressed by these second grade children would be ameliorated over time.

Clearly, mainstreaming can be effective. In addition, deaf students are likely to feel more positive about themselves when they find they can learn along with regular peers. It is likely that regular students will be more accepting of handicapped students when they all learn together.

Many questions require further research including the impact of having handicapped students in class on the cognitive gains of regular students, and characteristics of teacher training necessary to achieve a successful mainstream class.

References

Hadary, Doris E. et al. "Breaking Sound Barriers for the Deaf Child." Science and Children 14:33, Nov./Dec., 1976.

Hadary, Doris E. et al. "Interaction and Creation Through Laboratory Science and Art for Special Children." Science and Children 13:31-22, March, 1976.

Hadary, Doris E. et al. "Picking Up Good Vibrations From Science for the Handicapped." The Science Teacher 42:12-13, December, 1975.

Hadary, Doris E. and Susan Cohen. Laboratory Science and Art for Blind, Deaf and Emotionally Disturbed Children: A Mainstream Approach. Baltimore, Md.: University Park Press, 1978.

Hadary, Doris E. and Nicholas J. Long. "Twenty-Five Field Tested Science Lessons for Elementary Age Pupils With Special Needs." Mimeographed, 1975. The American University, Washington, D.C.

Hadary, Doris E., Nicholas J. Long, and William Griffin. "A Research Evaluation of Specialized American Curriculum for Emotionally Disturbed Pupils in Elementary School." Mimeographed, 1973. The American University, Washington, D.C.

Linn, Marcia C., Doris E. Hadary, Richard Rosenberg, and Robert Haushalter. "Evaluation of Ideal Mainstream and Resource Programs to Teach Science to Deaf Children." Paper to be presented 1978 AERA Annual Meeting. (To be published.)

Long, Nicholas J. and Richard Rosenberg. "A Sociometric Study of Mainstreaming Handicapped Children in Science Classes." (To be published.)

Struve, Nancy L., Doris E. Hadary, Herbert D. Thier, and Marcia C. Linn. "The Effects of an Experiential Science Curriculum for the Visually Impaired on Course Objectives and Manipulative Skills." Education of the Visually Handicapped 7 (1):9, March, 1975. The Official Publication of the Association for Education of the Visually Handicapped.

Struve, Nancy L. et al. "The Effect of an Experiential Science Curriculum for the Visually Impaired on Course Objectives and Manipulative Skills." Exceptional Children, April, 1974, p. 516.

Thier, Herbert D. and Doris E. Hadary. "We Can Do It, Too." Science and Children 11:7-9, December, 1973.

Program Films

Laboratory Science and Art for the Blind, Part I. 16 mm. 18 minutes. Color.

Laboratory Science and Art for the Blind, Part II (Advanced and Gifted Handicapped). 16 mm. 18 minutes. Color.

Touching Science.

Mainstreaming Laboratory Science and Art.

Slide Presentations

Laboratory Science and Art for the Blind.

Laboratory Science, Music and Art for the Blind.

Laboratory Science and Art for the Deaf.

Laboratory Science and Art for Special Children.

Mainstreaming, How It Works in the Science and Art Room for Deaf, Blind, Emotionally Disturbed and "Normal" Children.

History: Laboratory Science and Art 1972 - Present.

MAINSTREAMING VISUALLY HANDICAPPED IN BIOLOGY

Dorothy Tombaugh

Mainstreaming visually handicapped students in biology presents no major problems. A few improved techniques which benefit both sighted and non-sighted, a little extra consideration on the part of both groups and a sense of team participation are all that is required. There is little need to have added expense for special equipment. Most items can be readily produced by students, teachers and friends.

The program discussed in this paper originated at Euclid Senior High School, Euclid, Ohio. It has been used for average and above average college bound sophomores. It was continued in the second year biology course for seniors.

The objectives of the BSCS Green Version Biology (2nd edition) serve as a basis for the program. Six of these goals start with "an understanding of . . ." and the seventh with "an appreciation of . . ." Visual acuity and technical ability with a microscope are not necessary for success in biology. The use of student teams provides the handicapped an opportunity to be active partners in every laboratory investigation. Sighted lab partners normally depend upon each other, so minimal dependence by the blind students upon others does not require a change of procedure. When microscopes are shared by two sighted students, it is seldom on a 50-50 basis. Learning is not impaired for partners where one continually furnishes verbal or raised drawings of his observations while the other reports on interesting items from his reading.

Preparing Slides

Standard prepared slides are often used in biology. These are interpreted by Braille paintings for the blind. A sketch of the microscopic view is outlined with Elmer's glue. More pronounced raised lines are made by pressing string and rope into the glue to represent cell membranes and walls. Further elaboration is done by using straws, pieces of tubing, beans, peas and radish seeds to depict cell inclusions. These paintings are correlated with the descriptions and sketches in the text and laboratory manual.

Dissection

Some students have prior experience with dissecting tools but only a few have tactile sense sufficient to benefit from the dissection of earthworms. Scissors, mall probes and forceps are preferred to scalpels in the dissection of frogs and fetal pigs. There is as much excitement in feeling a beating frogs heart and checking the expansion of the lungs as there is in seeing the phenomena. The animal skull, the human skeleton, the life-size torso model and one's own muscles serve for the final unit in anatomy.

Chemical Formulas and Equations

To prepare students lacking the prerequisite chemistry for the advanced biology course, selected chapters from a chemistry review book were Brailled for summer perusal. Organic structural models are used to study by counting cells with a microscope. A blind laboratory assistant suggested collecting carbon dioxide by displacement of water as in fermentation to indicate yeast population. Graduated cylinders are good containers for collecting the gas. The volume can be read directly by the sighted students. The non-sighted students weigh the water remaining to determine the amount of gas formed. A graph of daily readings gives a curve indicating a population in a closed enironment.

Chlorella and Euglena replace bacteria to teach sterile technique. These microorganisms are grown on minimal media which lacks glucose and beef extract in order to reduce the possibility of contamination and to eliminate pathogenic opportunists capable of growth on nutrient agar. This was first done so blind students could touch colonies of Chlorella to determine if growth had occured. It was continued for all students. Warmth from the Bunsen burner guides the hand in flaming the inoculating loop. Streaking a Petri dish presents no problems. Broth cultures are best in wide mouth flasks. For study with the Gram stain, the blind student prepares and stains slides of microorganisms. The sighted partner describes the microscopic view and draws it on clay.

The passage of glucose through a membrane is shown by a color change in Tes-tape. This experiment was changed to include other substances which involve formation of precipitates. The sulfosalicylic acid test for albumin, silver nitrate test for the chloride ion, limewater for carbon dioxide and Benedicts solution for maltose were among the additions. With more tests the sighted and non-sighted have a better investigation.

The rate of diffusion is shown in the senior course by weighing at timed intervals membrane tubes containing sucrose solutions of varying concentration. The data is plotted on Braille graph paper to show the equilibrium curves. Graphing techniques designed for the blind are usable for demonstration models for the whole class. The wire mesh graph uses lines of various colors of ribbon, yarn, string and rope. Pegboard using dowel rod and golf tees to mark points for graphing is another way to use both visual and tactile demarcations.

Field Trips

Field trips offer enjoyment and learning for all. The Natural History Museum affords a special program on the ecology and behavior of wild animals native to this area. Some of their tame young animals are available to be held. Fossils and artifacts will be brought out of storage for examination if prior arrangement is made with the staff. A museum volunteer may act as a special guide while the class looks at the exhibits.

For an excursion to the zoo, fellow students are good guides. A big cat, a bear and an elephant no longer leave a cuddly stuffed animal impression when one hears their calls and listens to their feet touch the concrete. The petting zoo offers an opportunity to become acquainted with semi-domesticated animals. The sounds of the multitude in the bird building give an unequalled impression of diversity in the animal kingdom.

The field trips on the nature trail at the arboretum and in Metropolitan Park are preceeded by classroom use of tapes of common bird calls. Tree characteristics are noted and leaves collected for use in preparing a dichotomus key. The blind students introduced new concepts in classification by texture, odor and frequently overlooked details particularly in stems. They should produce a totally new key for plant identification.

Genetics

The study of genetics begins with an investigation of probability in which coins are tossed for heads and tails. Calculations can be done algebraically or on Punnet squares on Braille paper. Fruit flies are too small for visually handicapped students to discern structural differences. Genetic corn, however, is excellent for experiments. Green and albino corn ratios can be identified by the difference in the texture of their leaves. Tall-dwarf plants are easily separated a week after germination. These characteristics are available in monohybrid and dihybrid crosses. Dried ears of corn showing smooth-shrunken alleles can be counted by touch for use in genetic problems.

Blind Student Originality

The accomplishments of the blind students in biology are shown best in the variety of research projects undertaken. Many experiments are possible with microorganisms when there are suitable ways to measure growth. Yeast and algae can be grown with various sugars, media, minerals, vitamins, and antibiotics to give suitable variables. The quantity of Chlorella was first estimated by growing sufficient quantity to filter, dry and weigh. A more accurate method is to measure the density of a broth culture with a B and L spectrophotometer. When electronic meters reading in sound can be added to this instrument they can work unaided. The students prepared all of the chemicals and media used in these experiments.

The study of plants is a favorite topic. Not only does it provide a wide range of subjects for research at school, but it leaves a store of useful techniques for growing plants in the house or garden. Manual dexterity is evident in a project for which the blind student did the tomato-potato grafts. The sighted partner did the tests for vitamin C content of the plants as his contribution.

Behavior can be studied in animals as small as the meal worm, Tenebrio. Among the vertebrates the land tortoise is a favorite subject. Our tortoises cooperated by eating a wide varity of foods to establish food preference. Hash of various hues was fed to them in order to show their color preference. During environmental studies bells were taped to their shells so they could be located as they wandered about the greenhouse. The variations in color and texture of their eggs plus their small size make quail suitable for genetic experiments. Gerbils enjoy the extra attention afforded during metabolism investigations.

Tape recorders and Braille slates are used to collect research data. An abacus aids in mathematical computations. Formal, typed research reports complete with charts and graphs are expected at the completion of each project. When each student has an instrument such as the Optacon to free him to do his own library research, he will be even more independent in biology.

Any hesitancy in showing movies in classes with visually handicapped students present was quickly dispelled when it was learned one blind student could operate a projector and give a resume of films seen in junior high.

As a senior laboratory assistant, Bill helped design and test new techniques to be used with blind students in the sophomore class. He was the first blind person to enter a Science Fair in this area. The work on this project won a superior rating and an award. His major contribution, though, was in carrying the message BLIND STUDENTS CAN SUCCEED IN BIOLOGY AND IN LIFE.

BIBLIOGRAPHY

Bauman, J. A. Jr. and D. Zollman "Physics Labs for the Blind." The Physics Teacher, September 1977. Pp. 339-342.

Biological Sciences Curriculum Study. High School Biology BSCS Green Version First and Second Editions. Chicago: Rand McNally and Company, 1963 and 1967.

Bunner, W. R. and R. T. Bunner. "What About Your Visually Defective Students?" The American Biology Teacher, February, 1968. Pp. 108-109.

Hiemenz, P. C. and E. Pfeiffer. "A General Chemistry Experiment for the Blind," Journal of Chemical Education, April, 1972. Pp. 263-265.

Tombaugh, D. "Laboratory Techniques for the Blind", The American Biology Teacher, May, 1972.

Tombaugh, D. Biology for the Blind. Euclid, Ohio: Euclid Board of Education, 1973.

Filmstrip

Tombaugh, D. "Biology Laboratory Techniques for Blind Students". Filmed at Euclid Senior High School, Euclid, Ohio.

LUNCHEON, April 4 - Science Education, the Handicapped, and Careers

Maynert Kennedy, Biological Sciences Curriculum Study, discussed the BSCS model program for handicapped elementary students. A written message of support which is reprinted on the following page, was delivered to the conference from Senator Muriel Humphrey.

United States Senate

COMMITTEE ON
GOVERNMENTAL AFFAIRS
WASHINGTON, D.C. 20510

March 27, 1978

Dr. Helenmarie Hofman
National Science Teachers Association
1742 Connecticut Avenue, N. W.
Washington, D. C. 20009

Dear Dr. Hofman:

I regret that I am unable to be with you today, but I am pleased to note that the conference on Science Education for Handicapped Students is centering its attention on increasing the participation of handicapped individuals in science related careers. As you know, the problems of the handicapped and how they are resolved have been issues of great concern to me. This is a subject in which I have a deep interest both publicly and privately.

For too long, the special career needs of the handicapped have been given inadequate attention. The sciences offer a tremendous opportunity for challenging, professional careers for handicapped people. By bringing together expert participants who will focus their attention during this conference on these needs, new worlds of opportunity and achievement will be opened to those who may otherwise never have realized their potential.

I look forward to the results of your meeting with great interest and hope.

Sincerely,

Muriel Humphrey

Muriel Humphrey

SUMMARY - Mary Budd Rowe

A summary of the conference as presented by Mary Budd Rowe is outlined by the following notes and flowchart.

Early Exposure to Science

-- science as a powerful instrument

for assisting youngsters to begin the process of understanding the world outside themselves

for developing language and self-confidence

-- home delivery
-- elementary school

Handicapped Students in Regular Classrooms

-- diversity of stimuli

-- goal-setting

-- multisensory input adapted for various kinds of modalities

improvement of science education for everybody, not just handicapped; for example, socio-economically disadvantaged also benefit

Appropriateness of Assessment Techniques: Testing

-- time as a variable

handicapped students take longer to do this

research needed to reduce this time difference

Parents

-- responsibility

-- expectations

-- perceptions

-- exposure to toys, museums, etc.

Career Counseling

-- education of counselors

changing their expectations for the physically handicapped

-- early access to science and mathematics to be able to enter science as a career

-- equal access to human and physical resources of a school

Peer Education

-- social education

attitudes

values

-- misconceptions and misunderstandings

Socialization

-- introversion of science-oriented people in general

coupled with the isolation forced upon the handicapped

-- interaction - development of respect

builds through shared experiences

Role Models

-- someone to identify with

someone who believes it relevant and appropriate that the student pursue a science career

an impaired person learns about other impaired persons who have succeeded

Students

-- research into assessment techniques for impaired students can lead to discoveries about testing for all students

e.g., wait time research

-- development of expectations, attitudes about careers in science

-- each type of impairment requires special adjustments

social, psychological

safety factors in the laboratory

-- must deal with large amounts of energy, persistence, frustration

Retention

-- getting the handicapped to stay in regular programs once they're there

-- need support systems

peer support

support from non-handicapped persons

e.g., working with a group on a computer, etc.

Employer Education

-- interagency cooperation

-- cross-discipline

-- cross-peoples

Science as a Language Development Tool

-- strong positive long-gains in language may be made through science

A Recapitulation

This is a very complex system requiring cooperation from teachers, parents, handicapped, counselors, non-handicapped, government, private organizations, potential employers, researchers, planners, etc.

We need to put together feelings and ideas, knowledge and attitudes. Gwen Frostic's lovely poetry gives us a message that's relevant:

The lines of the wind blown sand on the dunes

- - - of the snow as it falls in beautiful drifts

the lines of the clouds

in the sky above - - - - -

and the water that washes upon the sands - - -

forever and ever these lines repeat - - - - - -

always and always

each one is unique . . . .

"So I'm part of the repeat, but I'm also unique."

Dry leaves rise in a gust - - - -

- - - tiny birds in little flocks - - -

gulls soar - - - - -

insects swarm - - - -

seeds whirl and sail - - -

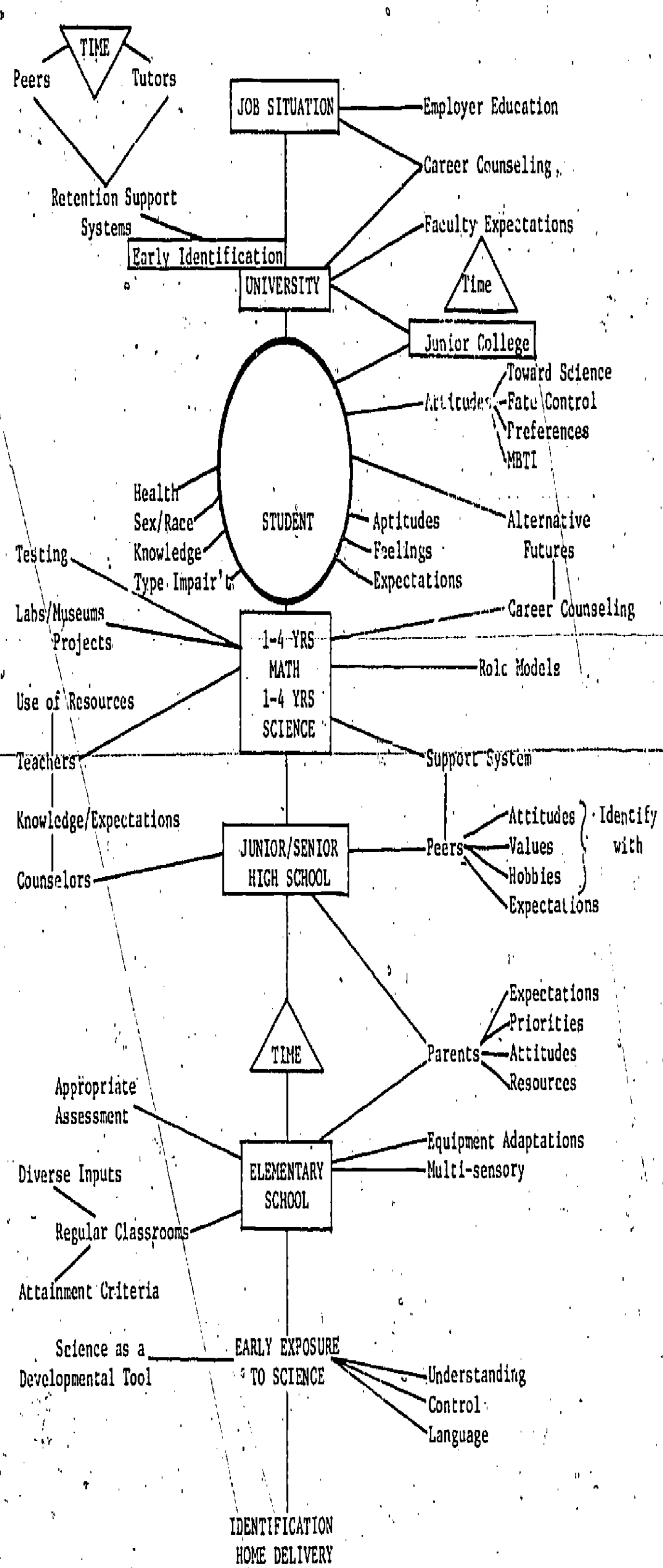
millions of times the formation repeats - - - -

each time - - - - each thing

unto itself is unique . . . .

Gwen Frostic
Poem from "Wing Borne"

"It's this paradox that we're trying to cope with - the pattern and the uniqueness. What the research does is tell us about the pattern. What teachers have to do is express the pattern individually - that's the uniqueness. All the stars on a clear, still night and all the leaves on a single tree, the many ideas that one may have, over and over the basic concept repeats. Yet each star, each leaf, each idea is unique."



SUMMARY - Alan Humphreys

A summary of the conference as presented by Alan Humphreys is reproduced below.

Learning is often measured in terms of behavior change. This conference has and will change my behavior, but I must say honestly that the words and talk and tests are, for me, far less effective than little folks like Ricky and Stephanie and all the kids at Michael Dowling School for Crippled Children who have helped me better understand the real world of courage, happiness, and boundless optimism. Browning asked, "If man's reach does not exceed his grasp, then what's a heaven for?" In my life, it has been little children and science that have best helped me to answer that question.

It is my understanding that the purpose of this conference is to provide guidance and direction in the development of a White Paper. Further, that the purposes of such a position paper are:

--to describe the current condition of science education for physically handicapped children in the U.S.;

--to describe the nature and the level of support needed so that educators can effectively comply with the several federal and state laws and regulations specific to the science education of handicapped children; and

--to suggest in clear and precise terms what we believe the facilitation posture of the several funding agencies should be.

Although the synthesis I have made is expressed in my words, I have tried to reflect honestly and sensitively what I have heard the participants say, collectively and individually.

First, we would like proposal selection criteria to be developed so that money is wisely assigned, but also so that all aspirants representing a wide range of needed developmental efforts will have fair and equitable access to funding.

Second, we believe that the clearinghouse concept needs to be translated and implemented into one or several functional centers--existing and new--which will provide a cascade of services including rapid access to studies, data, curriculum materials, selected bibliographies, and sources of instructional materials.

Third, pre- and in-service programs which provide specific information about and direct experience in the delivery of science for the physically handicapped child should be available from institutions, state and regional centers.

Fourth, any study, project, workshop, dissemination program, etc., to be funded, regardless of nature or purpose, must define its purposes and expected outcomes in operational, measurable terms and must expect to submit a detailed description for publication and a detailed account of the accomplishments, data, and/or fundings derived.

To this end, there needs to be a full-time, funded person (perhaps a member of the NSTA staff) whose task would be to coordinate these efforts.

We said many other things. These are included in the extensive group reports. We are in reasonable agreement that:

1. Physically handicapped children must have good K-12 science education available in the least restrictive environment.
2. Hands-on, multi-sensory activities offer great promise as an an effective science instructional methodology for all children.
3. Science career information should be, when appropriate, incorporated into science courses and counseling courses at all levels and should be available to and used by elementary, middle, and high school guidance counselors, as well as teachers.
4. Although the central thrust must be sound science education at all levels of instruction, activities aimed at building confidence, providing access, reducing bias and prejudice, and engendering supportive behaviors by teachers and children (often called attitudinal education) need to be developed as an integral part of any science education program as needed. It should be noted that this calls for empathetic support focused toward maximizing independence and developing the fullest self-responsibility level on the part of the handicapped child.

POSITION STATEMENT

To assess the state of the art and develop recommendations for new directions in science education and careers in science for the physically handicapped student, the National Science Teachers Association (NSTA) convened a conference on Science Education for the Physically Handicapped Students. The conference was supported with a grant from the National Science Foundation (NSF). The ultimate objective of this conference was to affect the quality of science education for the physically handicapped student. Through working sessions the conference participants developed a position statement on science education for the physically handicapped student. (Refer to the appendices--terms and participant list.)

Handicapped children have a right and a need to learn basic science content and skills. Evidence presented at the conference indicated that handicapped children are interested in and capable of learning science. Handicapped students have similar needs to those of non-handicapped students, therefore, it is necessary that equal education opportunities be offered to handicapped students.

Science courses should be an integral part of the education of all handicapped students from kindergarten through high school. Physically handicapped students should receive the same comprehensive exposure to the various fields of science as do non-handicapped students. Aspects of the science curriculum should include process, content, and career education with emphasis placed on early childhood and elementary programs as well as middle/junior high school and secondary school science programs. The teacher who teaches science to the physically handicapped must possess a strong comprehensive science background. Science teachers utilizing multi-sensory instructional techniques and laboratory-centered programs are able to effectively teach physically handicapped students in regular classes or special classes. The instructional strategies, techniques, and procedures found to be effective with the physically handicapped in science are those also found to be effective with the non-handicapped student. A great need exists for the dissemination of educational information about science materials, teaching aids, techniques, conferences, workshops, etc., to both the regular and special education teachers who teach science to the handicapped students.

Although many of the conference recommendations are somewhat costly, failure to meet these obligations will most probably be more costly in terms of the loss of the physically handicapped individuals' particular contributions to science and/or society. The societal loss will be professional, human, and economic. The anticipation of this loss provides the necessary rationale for following through on these recommendations.

STATE OF THE ART

The way to begin eliminating obstacles to the success of physically handicapped students in science education is to identify the specific problems. Knowledge of what exists in the field is essential. Based on the expertise, evidence, and experience presented by the conference participants, an overview of the state of the art for science education for physically handicapped students is presented here.

Conceptual and practical experiences assist all students in preparing for life. If educators will help the handicapped student to understand, use, and appreciate science, then these students may be more able to consider science or related fields as career possibilities. Science is a vehicle for the development of children. The study of science helps meet the psychomotor, psychological, and social skill development needs of both the handicapped and non-handicapped students.

Through sections on science education, careers, teacher education, materials, and evaluation/assessment present positive and negative practices are presented.

SCIENCE EDUCATION

Present positive practices:

- A current trend exists to involve handicapped and non-handicapped children in science experiences at an early point in their schooling.
- Individualization in curriculum planning--specific to the

student's needs--helps prepare for the ongoing implementation of Education of the Handicapped Act, PL 94-142.

- Placing handicapped students in the most appropriate, least restrictive educational environment is mandated by PL 94-142. This includes science education.

- The trend to remove major architectural, communicative and attitudinal barriers in the schools facilitates learning in science as well as other areas by physically handicapped students.

Present negative practices:

- Science is not considered an important component of the curriculum for physically handicapped students.

- Physically handicapped students are not receiving comprehensive or regular exposure to sciences at any educational level.

- Present programs, facilities, and instructional strategies have not been adapted to meet the needs of the physically handicapped students in both special groups and mainstreamed science courses.

- Teachers are not always aware of and sensitive to the unique needs of the physically handicapped student.

- Teachers tend to limit themselves to visual or auditory strategies of instruction which may penalize some physically handicapped students.

- Presently, there exist negative feelings about mainstreaming the physically handicapped student that stem from a number of stereotypes, e.g., the stereotype that physically handicapped are also mentally handicapped.

- Many physically handicapped students are being barred from science courses, especially those courses that include laboratory experience, by physical barriers, teachers with negative or fearful opinions, overly cautious counselors, apprehensive parents, etc.

- PL 94-142 is often abused by mainstreaming handicapped students into disappropriate programs.

- When physically handicapped students are placed in regular science classrooms, the teacher generally has not been adequately prepared for the placement of these students, and has not been provided with the insight, special materials, skills, and/or techniques to effectively help the physically handicapped student learn science.

CAREERS

Present positive practices:

- A recent trend addresses the need for opening career possibilities, through presenting role models and identifying educational prerequisites to science or science related careers for handicapped students

Present negative practices:

- Generally, science teachers are unfamiliar with the various career opportunities available in science and related fields for the physically handicapped student.

- There is no central information dissemination system, or source, serving as a resource for persons interested in career opportunities in science for the physically handicapped.

• While schools are becoming more accessible to handicapped students, most schools have not and are not currently hiring handicapped teachers for regular classes.

TEACHER EDUCATION

Present positive practices:

• There are teacher education programs to prepare teachers for integrating the physically handicapped into regular science classrooms; however, these programs are limited to the efforts of a few individuals.

• Some teachers who have expertise with a particular disability group are beginning to share findings with other teachers.

Present negative practices:

• The attitude of science instructors, career counselors, and employers toward handicapped students is often neither encouraging nor appropriate.

• Little agreement has been reached as to what new skills and knowledge science teachers should possess to be competent in meeting the learning needs of handicapped students who enter regular classrooms.

• Many science teachers (especially elementary level) do not have enough knowledge of science education to make appropriate adaptations for special students; or they do not have enough familiarity with the facilitative mechanisms of the various disabilities of handicapped students to understand what adaptations are necessary for an optimal learning environment.

• Most pre-service teachers, in-service teachers, and paraprofessional science education programs have not had to consider the needs of the handicapped.

• Many teachers and counselors have inaccurate expectations of handicapped students which often result in poor student performance.

• Some teachers are over-sympathetic toward their handicapped students; this does not allow the handicapped students equal opportunity for academic success and/or failure.

MATERIALS

Present positive practices:

• Curriculum development efforts have demonstrated that physically handicapped students can and, indeed, do succeed in science classes at the elementary, secondary and post-secondary levels, often with minimum equipment adaptation.

• Major financial support for materials is not necessary to teach many science concepts to the handicapped student; however, creativity is needed. Science with everyday things (i.e., tin cans, rubber bands, paper clips, etc.) can be an invaluable learning experience, particularly at the elementary level.

• The handicapped student can be a valuable human resource in the classroom with respect to his/her handicap (if and only if it is a comfortable situation for students).

• The use of the hands-on approach for a portion of class time in science, rather than only lecture and demonstration makes the knowledge more accessible, meaningful and more appealing to handicapped and non-handicapped students.

- The use of partners (mutual choice) for some handicapped students has proven to be quite helpful in the science classroom laboratory.

- The multi-sensory approach is being used by some science teachers. This practice in the mainstreamed classroom can be very successful. It allows the visually, auditorially or the orthopedically handicapped students as well as the non-handicapped students to expand their science experiences.

Present negative practices:

- At all educational levels there is no current systematic way in which knowledge, resources, materials, etc., on teaching science to the handicapped can reach the classroom teacher on a regular basis.

- There is an apparent lack of materials and/or adaptations in science for the handicapped at various levels and in various science disciplines.

- Most teachers do not have time to devise creative adaptations and materials for science education for handicapped students.

EVALUATION/ASSESSMENT

Present positive practices:

- The research on special programs in science education developed for a particular handicapped group in some model program is commendable.

Present negative practices:

- Two recent nationwide surveys indicate that the major percentage of handicapped students are not receiving a quality education in science. A study done by Dr. Benjamin Thompson, University of Wisconsin-Eau Claire, 1976, revealed that state and/or other agencies have virtually no available information relative to science and the handicapped. The American Association for the Advancement of Science "Project for the Handicapped through Science" survey, directed by Dr. Martha Redden Ross, 1976, indicated that handicapped students receive little science institution and what they do receive is not academically adequate to allow them to pursue science, science education, or science related fields as possible careers.

- There is no clearninghouse to provide teachers with information about science education materials, resources, etc. concerning science education for the physically handicapped student.

- There are a few definitive studies on how various handicapping conditions themselves influence teaching methods, materials, and activities used to teach science.

- There are no definitive studies detailing which of the programs and strategies currently available are most appropriate to the learning problems presented by the various handicapping conditions.

- Many of the programs, materials and learning activities developed to enable physically handicapped individuals to participate in science education have been designed for specific individuals or for groups of individuals with a similar handicap.

condition. Consequently, the content, appropriateness, and flexibility of these activities for use with many individuals over the broad spectrum of physically handicapping conditions is not known.

RECOMMENDATIONS

The recommendations that emerged from the conference address concerns about current and future problems in providing quality science education for physically handicapped students.

CAREER CONCERNS

Handicapped students should have equal opportunities to pursue science related careers.

- Careers in science should be included among areas of career exploration and skill development for handicapped students; i.e., science should be an integral part of career awareness, exploration, and vocational preparation programs.

- Appropriate rehabilitation agencies personnel should be made aware and provide for many handicapped persons who need long-term educational preparation rather than short term preparation for semi-professional or semi-skilled and unskilled positions.

- Counseling and guidance training programs should be encouraged to include components pertaining to employment opportunities for the handicapped in various areas of science in their pre-service and in-service curricula.

- Projects which encourage the preparation and dissemination of information concerning career decision-making for handicapped students should be supported. This information should include role models, career sketches, and further resource contacts, and should be disseminated to elementary and secondary schools.

- The skills, experiences, and abilities of successful and established physically handicapped scientists and science educators should be fully utilized in developing, implementing, and encouraging the science education and employment of the physically handicapped.

- Science and science education associations should assist science oriented employers in becoming knowledgeable about the physically handicapped person's potential.

- Where possible and desirable, physically handicapped students should have a work-study experience in science.

- A network for the dissemination of career awareness, information and opportunities should be developed to inform science teachers, career counselors, physically handicapped and non-handicapped students of possible employment opportunities in science or science-related professions.

- Science career awareness, information, and opportunities for physically handicapped and non-handicapped students, i.e., career education, should be a part of the regular science instruction process.

TEACHER EDUCATION

Pre-service teacher education programs should prepare prospective classroom personnel to teach science to handicapped students; and in-service programs should provide school personnel access to current information on teaching science to handicapped students.

- Education of the handicapped should permeate the whole teacher and counselor program. Special emphasis should be placed on increasing sensitivity to and awareness of the unique needs of the physically handicapped student as well as the needs of students with other special learning needs in science classes while emphasizing the similarities to non-handicapped students.

- The training of special education teachers of physically handicapped students should include specific science instructional methods and curriculum materials that have proven to be successful.

- Teacher education programs should provide pre-service teachers with opportunities to work with physically handicapped students and to observe these students learning science in regular and special science classes conducted by effective science teachers wherever possible.

- Pre-service teachers, in-service teachers, and para-professionals should be trained in preparing Individualized Education Plans (IEP).

- Funds for special education teachers should be provided to permit them to attend training workshops and institutes on teaching science to the physically handicapped.

- Funds should be provided to facilitate the training of teachers in the modification of instructional strategies, materials, and equipment to meet the needs of the physically handicapped student in science courses.

- Teachers should have access to guidelines and principles for the adaptation of existing science programs/materials (i.e., in-service) and support from resources and personnel.

- In-service teacher education programs should be provided for school administrators and counselors by professionals who have taught science to physically handicapped students in regular and/or special science classrooms.

METHODS

Methods used in teaching science to physically handicapped students should provide opportunities for them to learn how to be independent learners and how to interact with non-handicapped persons.

- The science classroom environment should be as natural as possible.

- In helping the physically handicapped student solve problems, the teacher should limit their assistance so that the physically handicapped student has a basis for independent action to be transferred and utilized in the "real" world.

- Science teachers should encourage physically handicapped students to pursue independence in learning and augment that independence with strategies such as peer teaching.

- Non-handicapped students and physically handicapped students should work together when possible using scientific problem-solving to invent techniques and devices to assist one another in learning science.

- Science courses for non-handicapped and handicapped students should include as much hands-on activity as appropriate.

- Science educators should urge physically handicapped students to participate in science fairs and other science competitions sponsored by such organizations as the Junior Academy of Sciences.

MATERIALS/PROGRAMS

Special consideration should be given to the identification and development of instructional materials/programs that will help eliminate the barriers to the study of science for physically handicapped students.

- Funding agencies should give special preference to funding science programs which include the physically handicapped at the elementary, middle school and secondary levels.

- Curriculum development projects which provide for the physically handicapped students in science should be undertaken.

- In addition, in curriculum development, emphasis should also be placed on the adaptation of existing curricula as well as on developing new curricula for the physically handicapped.

- It should be required in the development of new curricular materials that attention be paid to illustrations in pictures and text. Such materials should include the physically handicapped as role models, both as students and as scientists in scientific courses.

- Funding should be made available for all related services (i.e., braillers, recorders, computers, group hearing aids, interpreters, etc.) to enable the physically handicapped student to participate in the normal activities of science education.

- Specialized materials such as captioned films, or materials developed by organizations like the American Printing House for the Blind must be made available to the regular classroom teacher of mainstreamed physically handicapped students.

- Parent education is needed to inform parents about materials and instructional aids and services that are available to facilitate the science education of their physically handicapped child.

DISSEMINATION

In order for classroom teachers and counselors to plan and implement desirable science programs for physically handicapped students it is essential that they have on-going access to current and relevant information.

- The curriculum materials now available for teaching science to physically handicapped students need to be disseminated in a variety of ways.

- The development and dissemination of a newsletter concerning physically handicapped students in science education would help inform teachers and other physically handicapped students who may wish to pursue science.

- Publications, conferences or workshops devoted especially to science education for the physically handicapped should be "announced" in journals widely read by regular classroom teachers.

- Professional education journals should have regular features on science education for the physically handicapped student.

- Science Education for the Handicapped Conference Proceedings and position paper should be announced through educational journals and newsletters.

- A central clearinghouse should be developed which would provide resources in the following areas for the science education of all handicapped persons:

  a. Career opportunities and career education materials
  b. Teacher training
  c. Curriculum development
  d. Personal aids to assist learning
  e. Science education for handicapped students

Such a clearing-house would make these resources available for widespread distribution.

- Educational Resource Information Center/Science Math and Environmental Education Clearinghouse should receive information such as the following:

  a. The proceedings and papers produced during this conference and other conferences on related topics.

  b. Articles and papers relevant to science education and physically handicapped students.

  c. ERIC/SMEAC should search for and encourage the submission of articles and papers relevant to science education and the handicapped student.

ERIC/SMEAC information must be made available at little or no cost to science teachers. One way to do this would be to develop a hotline phone number available free to classroom teachers at all levels for gaining access to the ERIC/SMEAC system; and to advertise this service in professional journals.

- Science teachers must have easy access to the holdings of the Bureau for the Education of the Handicapped clearinghouses for materials for the handicapped such as the National Clearinghouse for Educational Media and Materials for the Handicapped.

- Professional educational conventions, both national and regional, that are related to science education should encourage and recruit displays and presentations by people who have been involved in science education for the physically handicapped student. All such conventions should be barrier-free.

EVALUATION/ASSESSMENT

In the absence of a body of empirical knowledge on teaching science to handicapped students, systematic efforts to gather, organize, synthesize and disseminate this knowledge should be conducted.

- Funding in science education for physically handicapped students should be increased to include curriculum development, research, evaluation and dissemination.

- Agencies responsible for research in education should be encouraged to do more empirical research on science education for the physically handicapped.

- Research should be conducted on the specific instructional strategies and techniques, and instructional equipment that facilitate learning for the physically handicapped.

EDUCATIONAL ORGANIZATIONS AND AGENCIES

Each professional education organization and agency should be actively concerned with the rights and needs of physically handicapped students to be taught science in an appropriate classroom setting.

- Each science education organization/agency should accept major program responsibilities toward planning and implementing science education for the physically handicapped.

- All boards of science education organizations should include representation of/for physically handicapped individuals as well as a science educator who had experience with physically handicapped students.

- Standing committees on science education for the physically handicapped student should be established within science education organizations/agencies at both national and regional levels.

- Presentations on handicapped students should be planned for all science education conferences. When appropriate, these presentations should be directed to the general assembly of science teachers, not to small groups.

- Professional science education and scientific organizations should develop strategies for informing legislators and agencies of the educational needs of the physically handicapped in science and should support the formation of a special commission to study the problems and recommend strategies.

- General guidelines should be established for facilitating safety in the laboratory. A handbook on recommended adaptations that science teachers can make to accomodate physically handicapped students in regular classrooms and laboratories should be published and periodically updated.

- Funding institutions should support summer science programs which include physically handicapped students.

- All television program sponsored or approved by educational organizations/agencies should include captions and/or interpretors.

- Appropriate science activities should be incorporated into programs of community organizations such as scouting groups, YMCA, YWCA, museums, parks, etc., which should actively seek participation of the physically handicapped.

APPENDIX A - A Definition of Terms

PHYSICALLY HANDICAPPED STUDENTS	: For the purpose of this conference physically handicapped students were defined as visually, auditorially and orthopedically impaired students in kindergarten through twelfth grade with one or more of these handicaps and fall within the average and/or above average range in intelligence (as measured by either verbal or non-verbal instruments).
AUDITORIALLY HANDICAPPED	: Impairments affecting hearing ability totally or partially.
ORTHOPEDICALLY HANDICAPPED	: Impairments of muscle control to the limbs.
VISUALLY HANDICAPPED	: Impairments affecting sight totally or partially.
P.L. 94-142	: Public Law 94-142 Education of the Handicapped Act.
504	: Section 504 of the National Rehabilitation Act of 1973.
I.E.P.	: Individualized Education Program means a written statement for a handicapped child that is developed and implemented by school personnel in compliance with parents and students.
MAINSTREAMING	: Mainstreaming refers to the temporal, instructional and social integration of eligible exceptional children with normal peers based on an ongoing individually determined educational planning and programming process and requires classification of responsibility among regular and special education administrative instructional and supportive personnel. (Kaufman, Gottlieb, Agard, & Kubic, 1975)
NSF	: National Science Foundation.
SHA	: Science for the Handicapped Association.

APPENDIX B - Conference Committee

CESI : Council for Elementary Science International.

AETS : Association for the Education of Teachers in Science.

NSTA : National Science Teachers Association.

AAAS : American Association for the Advancement of Science.

BEH : Bureau of Education for the Handicapped.

BSCS : Biological Science Curriculum Study

CEC : Council for Exceptional Children.

MSSD : Model Secondary School for the Deaf.

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APPENDIX E

The National Science Teachers Association

A WORKING CONFERENCE ON SCIENCE EDUCATION FOR HANDICAPPED STUDENTS

April 3,4,5, 1978, Washington, D. C.

QUESTIONNAIRE

In order to evaluate this NSF sponsored project, we would like you to fill out this questionnaire about the NSTA conference on Science Education and the Handicapped.

Your input will be valuable to help us determine whether we have reached our goals

Thank you for cooperation.

Conference Committee, Science and the Handicapped

Section I - Facilities

A. Facilities: Good___ Fair___ Poor___

Comment(s) ______________________________

____

B. Assistance for Handicapped Participants: Good___ Fair___ Poor___

Comment(s) ______________________________

____

Section II - Background Information

A. Check the basis for your primary interest in this conference

1. ___Science Educator
2. ___Scientist
3. ___Parent
4. ___Special Educator
5. ___Career Educator
6. ___Counselor
7. ___Other (Specify) ______________________________

B. Check the handicap of primary interest to you

1. ___Visual
2. ___Auditory
3. ___Orthopedic
4. ___All

C. What did you hope to accomplish by attending?

____

____

____

____

Section III - Outcomes

A. Did you achieve your purpose for attending the conference?

___Yes ___Somewhat ___No

Explain ______________________________

____

____

B. What part of the conference did you find most productive? Please explain why:

____

____

____

C. What part of the conference did you find least productive? Please explain why:

____

____

____

D. What did you perceive the goals of the conference to be?

____

____

____

E. Were these goals achieved? Yes ____ Somewhat ____ No ____

Comments: ______________________________

____

____

F. If a similar conference was conducted in the future, what change(s) would you recommend:

General Comments:

QUESTIONNAIRE

Section I - Facilities

A. Facilities:

Good - 54%* Fair - 43% Poor - 3% NA - 0%

Sample Comments:

5 or more**

- Main meeting room too small

2 or more**

- Accessible, pleasant, better ventilated rooms than most hotels
- Carpets were hard to maneuver wheel chairs over
- Needed tables for "working"

Other

- Ramp from second level of parking garage needed
- Rooms were good size
- "I enjoyed my stay at the Sheraton National and so did my guide dog, Maggie."

B. Assistance for Handicapped Participants:

Good - 56% Fair - 20.5% Poor - 3% NA - 20.5%

Sample Comments:

- Pleased that funding was available for people to bring their own aids
- Rooms were too small
- Conference daily hours were too long for wheelchair participants
- Informal, but adequate
- Interpreter did an excellent job

* All percents are calculated on the number responding (39)
** Number of participants giving similar responses

Section II - Background Information

A. Check the basis for your primary interest in this conference:

1. Science Educator - 38%
2. Scientist - 10%
3. Parent - 3%
4. Special Educator - 8%
5. Career Educator - 5%
6. Counselor - 0%
7. Other - 8%
8. Combinations:

1 & 2 - 5%	2 & 7 - 3%
1 & 3 - 3%	3 & 7 - 3%
1 & 4 - 5%	5 & 6 - 5%
1 & 5 - 3%	3, 4, 7 - 3%

B. Check the handicap of primary interest to you:

1. Visual - 8%
2. Auditory - 13%
3. Orthopedic - 8%
4. All - 54%
5. Combinations:

1 & 2 - 5%	2 & 4 - 3%
1 & 4 - 5%	3 & 4 - 5%

C. What did you hope to accomplish by attending?

Sample Comments:

20 or more

- Find out what science teachers are doing to plan for handicapped students
- Learn basic state of affairs
- Find out about science opportunities for the handicapped
- Find out the needs of handicapped students and how that fits into science education

5 or more

- Develop recommendations for improving educational opportunities for the handicapped
- Make some recommendations with regard to careers
- Develop position statements
- Learn from others
- Incorporate new knowledge into professional courses
- Identify ideas that should be incorporated into pre- and in-service programs for teachers

2 or more

- Be a role model
- Contribute life experience as a handicapped person who became a scientist

Other

- To raise awareness about the need for positive attitudes
- "We accomplished the goals I was concerned about - now we must be concerned with implementation"

Section III - Outcomes

A. Did you achieve your purpose for attending the conference?

Yes - 85% Somewhat - 15% No - 0% NA - 0%

Sample Comments:

- Small group participation and sharing was "marvelous" - cross-fertilization from various fields was important
- Made useful contacts - gained insights and information
- Difficult to get out everything I had to say and wanted to do in such a short time
- People at the conference were aware of problems of handicapped in science courses
- Hopefully from hearing papers and meeting these handicapped people, people are more aware of the need for positive attitudes
- Depth of commitment to and understanding of the problem by NSTA members is very encouraging
- Good exposure to ideas, strategies, methodologies
- Implementation of conference recommendations should accomplish a change in the state of the art
- Highly successful conference

B. What part of the conference did you find most productive? Please explain why:

Sample Comments:

15 or more

- Group work sessions

5 or more

- Panel discussions
- Filmstrips, slide show, equipment demonstration
- Opportunity to interact with handicapped leaders
- Presentation of papers

Other

- White paper
- Focus on science education adaptations for handicapped
- Mary Budd Rowe's presentation
- Balance of presentation and interaction

C. What part of the conference did you find least productive? Please explain why:

Sample Comments:

5 or more

- Group work sessions
- Panels
- Reactants to panelists

2 or more

- Paper presentations
- People shouldn't have been allowed to go over the 10 minute limit
- Overprogrammed

Other

- Sleep (unfortunately necessary)
- Lectures and comments by US government representatives
- Sunday night get together

D. What did you perceive the goals of the conference to be?

Sample Comments:

10 or more

- Develop needs-statement paper
- Make recommendations

5 or more

- Define the state of the art
- Improvement of science education for the handicapped
- Pool information from experienced teachers

2 or more

- Cross-discipline exposure/interaction
- Dissemination of ideas for science for the handicapped
- Identify problems of handicapped
- Develop national goals and policy for science for the handicapped
- Make educators aware of handicapped students' needs and perspectives so that the teacher can act on them

Other

- To find out where science educators are in providing science education for the handicapped
- To evaluate current practices in science education and career opportunities

E. Were these goals achieved?

Yes - 64% Somewhat - 28% No - 0% NA - 8%

Sample Comments:

- Yes, if the final paper reflects our reports and is implemented
- Can't tell if the goals are achieved until the government and others take action
- What happens with the recommendations will tell
- Yes, through the interaction of the participants
- "I liked the cooperation and commitment of my group"
- The writing (i.e., "work" of the conference) came out better than one would have expected
- Yes, assuming this is the beginning

F. If a similar conference was conducted in the future, what change(s) would you recommend?

Sample Comments:

- Provide participants with the papers beforehand
- Narrower objectives - provide more time for consideration
- More time - to absorb, relax, meet with others
- More time for unstructured discussion and reflection
- Less structure, more interaction - more analysis of the material presented
- Better structure for initial group work - however, I thought the organization was outstanding
- Provide time for biologists to meet together just to discuss their concerns about handicapped students as biology teachers - same for chemistry, physics, earth science, etc.
- Exhibits, displays, demonstrations of material/equipment that works with handicapped students
- Booth set up with present programs for teaching handicapped
- More technical information on engineering science project adaptation for handicapped students
- More emphasis on higher education and career opportunities
- More emphasis on 1) science teacher training for handicapped 2) science career education for handicapped
- More meetings with people dealing with specific handicaps
- Longer working sessions, perhaps all morning or afternoon
- Bring in more educators not yet committed to our cause to get their point of view - we were a little one-sided
- Longer time for the conference, perhaps a week

G. General Comments:

Positive - 59%   Neutral - 5%   Negative - 10%   NA - 26%

Sample Comments:

- Good range of participants - many good people
- Participant selection was excellent
- Most valuable conference - I felt able to contribute and learn - participants brought super-good knowledge and experience base in science for handicapped - preparation and planning excellently done!
- General feeling was positive, despite criticisms - the real test of the conference will be if changes occur
- Time for informal rap sessions needs to be allowed
- Need to consider broader range of handicaps, including learning and behavior disorders
- I hope NSTA will seek funds to implement the recommendations from this conference
- Super conference! Funding needed for 4 days - per diem should cover real expenses
- Schedule was so rigid that there was little time to share ideas with other individuals
- Excellent conference - I appreciate being invited
- Wonderful sense of cooperation - I learned so much - I'm richer for the experience - I hope to share learning in the community - made friends at this conference - can't praise highly enough
- Thoroughly enjoyed, but I'm exhausted!
- Let us continue!